The FOUNDRY

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Castings Help Dig Tunnel Through the Rockies

SEVERAL weeks ago a blast of dynamite removed the last heading of a new tunnel which pierces the Continental Divide, thus completing at a cost of $12,000,000 an engineering project conceived 20 years ago by the late David Moffat, Denver banker. The Moffat tunnel, the largest in the United States and the sixth largest in the world, is expected to result in a great saving of both time and money,

Modern Machinery Enabled Engineers to Tunnel Under the Continental Divide in Four Years

since it will prevent great snow slides from tying up traffic on the railroad, will replace 23 miles of 4 per cent grade with 6 miles of 2 per cent grade and will shorten the distance between Denver and Salt Lake City on the Denver and Rio Grade Western railroad by 174 miles. Oil, water and power lines will be carried through the divide in a special 8-foot bore parallel to the main tunnel. The highest type of engineering skill has been required to overcome the many barriers erected by nature. The latest developments in machinery for boring into solid rock, handling the excavated material and pumping water from the bore, were employed in building the Moffat tunnel. Back of the modern equipment stands the foundry, since castings are used largely in the construction of the tools.

Find Where Castings Can Be Sold

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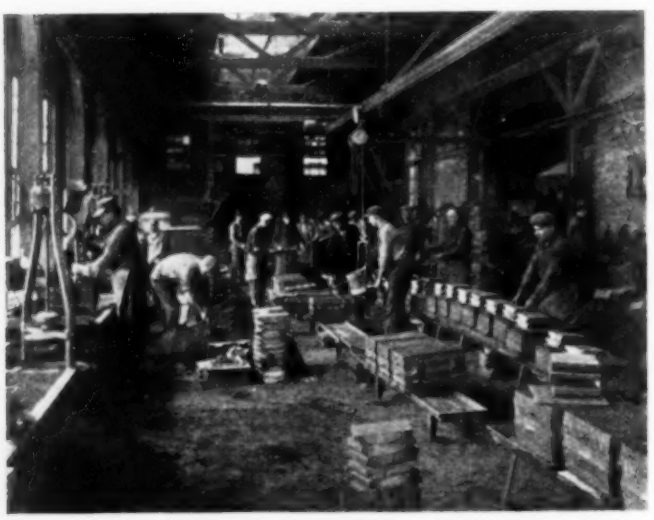
The MEN

In This Group One Man Has Been An Employe of the Company for Over 60 Years, One Over 40 Years, Four Over 25 Years and Eight Over 20 Years. Average of the Entire Group Is Over 15 Years. All Highly Skilled Craftsmen of the Old School

PROSPECT of a wider field and more adequate compensation for service, prompted William Williams, highly skilled melter and molder of metal to leave his native Wales where his ancestors had dwelt for generations, to venture forth into strange lands beyond the western sea. This is interesting of course, but not necessarily remarkable. Hundreds of thousands of Welsh men and women have done the same thing, despite the fact that as a race they are more than ordinarily attached to their native land, a land where they have maintained their identity, their habits and customs, even their language down to the present day.

Although an integral part of the tight little island, the territory is referred to as a separate entity as distinct as Scotland and Ireland. It is England *and* Wales if you please even if it has no cross on the Union Jack along with those of St. George, St. Andrew and St. Patrick. The national language has survived principally through its simplicity. Any native will explain that either in the written or spoken form it is one of the most simple of all languages. It is spoken exactly as it is spelled.

The remarkable feature of William Williams' journey is that it was not made since the present immigration restriction law went into effect. It was not made during what might be called the open season which prevailed during the closing years of the old and the opening years of the new century, years in which the immigration tide was at full flow. It was made at a time when steam navigation on the Atlantic was confined to one or two small vessels; when the majority of emigrants leaving the British Isles, set sail in some form of windjammer and considered themselves lucky if they set foot on the western hemisphere inside of two months. In a word, William Williams, founder of the business carried on for many years under the title E. A. Williams &



The PLANT

General View of the Molding and Pouring Floor in the Jersey City Foundry Which Was the Original Plant of the Company

THREE GENERATIONS BUILT Government Service Traditions

Son, Plymouth street, Jersey City, N. J., took prayerfull council with himself in the year 1847 —80 years ago—and as a result a few months later he found himself in the port of New York with liabilities in the shape of one wife, newly acquired before sailing, and assets including 1 kit of molder's tools, health, strength, ambition, dexterity of hand and eye and a comprehensive knowledge of his trade.

He landed on the dock, tightened his neck cloth, decided that now was the time for at least one good man and true to rally to the support of the party and find a place where he could do the greatest good to the greatest number. He needed no person to tell him that the greatest number is No. 1 in English, Welsh or any other language. He secured a job almost as soon as he landed and achieved quite a reputation as a highly skilled foundryman before he went into business for himself 10 years later in 1857.

He Was a Specialist

For a few years he worked in several local foundries and established a reputation for skill and knowledge that soon enabled him to specialize in the manufacture of particularly difficult castings and incidentally to improve his financial status to a material extent. He took his own melter and helper with him and traveled from foundry to foundry making difficult castings, beyond the capacity of the local foundrymen. For this service he was paid his expenses and the truly marvellous wage for those days of $10 per day.

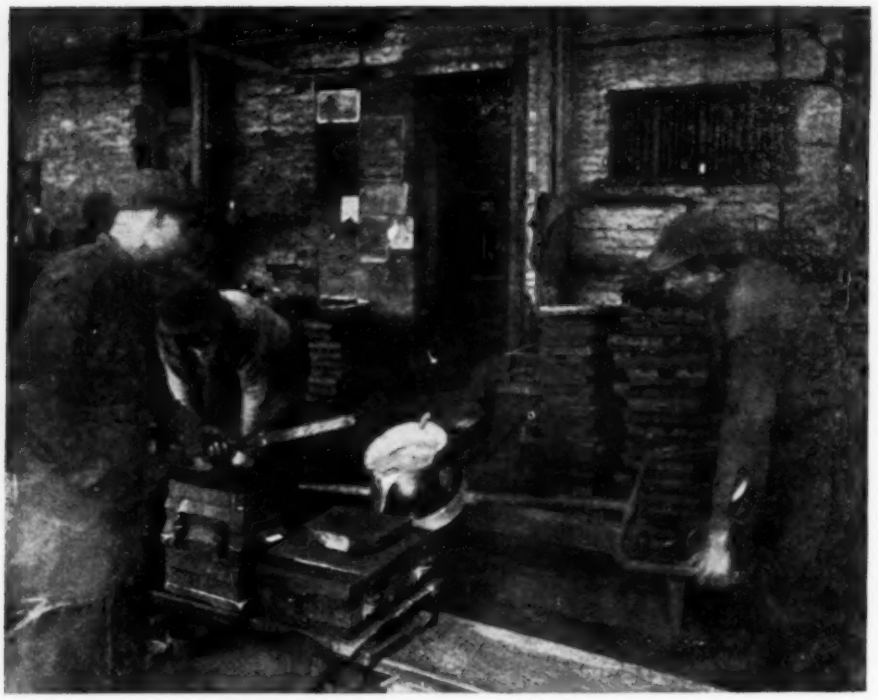
Desire to establish a definite home, to capitalize on his experience and knowledge and other local and personal reasons influenced him to join a relative named Conkey in erecting and operating a brass foundry on the site of the present building. When the plant was built it was close to the water front; so close in fact that sand and other materials were delivered by boat. In hot weather the workmen sought relief after pulling and pouring a few pots by running down to the dock and jumping into the tidal waters of the Hudson river. Today a maze of railroad tracks, streets and buildings covers the half mile of made land that separates the present plant from the water's edge. Seventy years is a long period in the history of a place which has grown with the speed of New York city and adjacent communities. Probably the surface of the earth and the contour of the river banks have changed more in the past 100 years than they did in all the centuries that elapsed before that time.

On the death of Mr. Williams a few years later, the firm of Williams & Conkey was dissolved. Conkey went into business for himself, but failed about a year afterward. The original business was continued by the widow of the founder Mrs. E. A. Williams, assisted by her 16-year old son Thomas H. Williams. Mrs. Williams remained in active charge of the business until 1867 when the active management was taken over by her son Thomas H., father of the present Thomas H., Jr. Thomas H. Williams, Sr. continued in control until his death in 1907 and during his term of office the business expanded to a gratifying extent and became one of the mostly widely known nonferrous jobbing foundries in that section of the country.

With all of this reference to William Williams, Thomas H. Williams Sr., and Thomas H. Williams Jr., the ordinary reader may be pardoned

The PRODUCT

An Exhibit Prepared by the Company in Connection with an Exhibition of the Important Industries of Jersey City



Each Molder Pours His Own Castings, Thus Avoiding Divided Responsibility

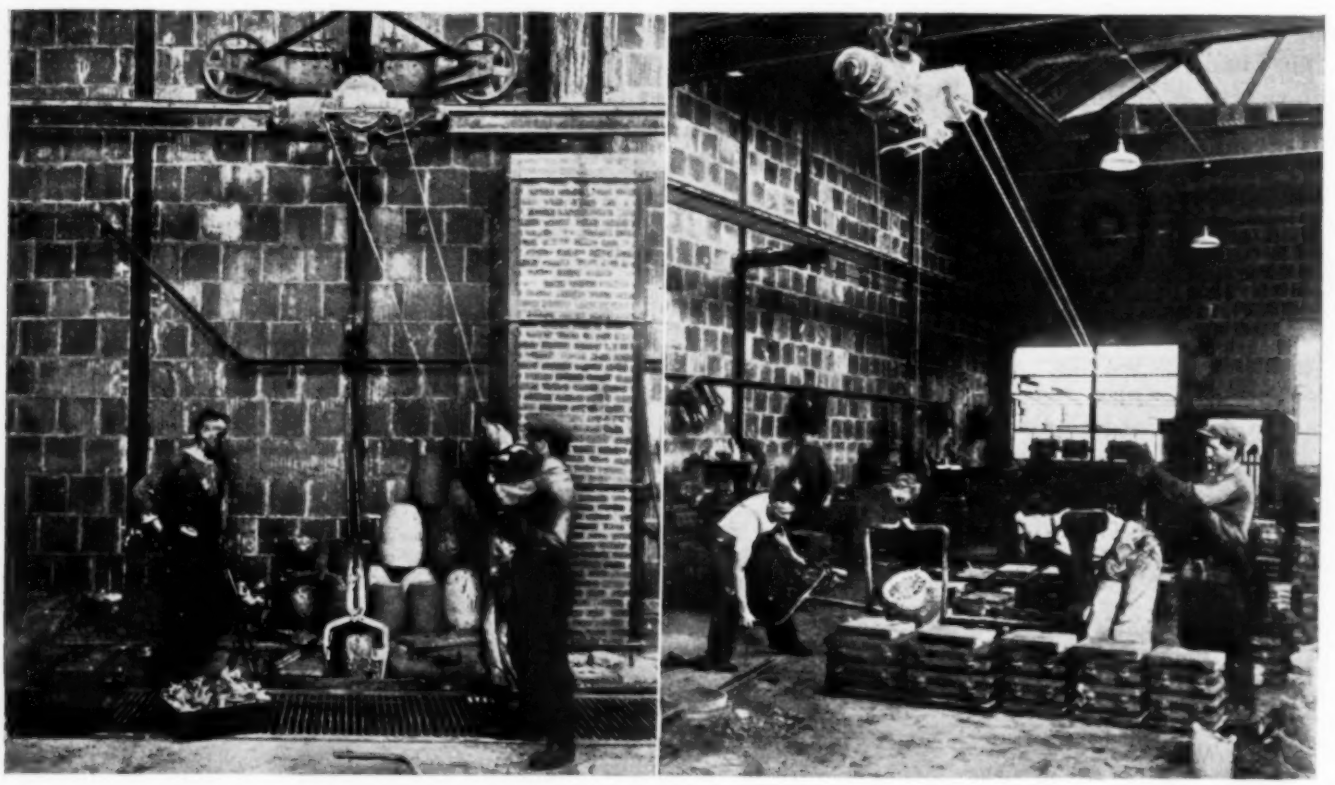
for wondering why the firm is known as E. A. Williams & Son. Behold Eliza Ann Williams, the E. A. of the title, widow of the first man, mother of the second, grandmother of the third and according to a tradition of the family the equal of any of them. Every member of the Williams family is and has been a skilled molder and melter. Eliza Ann was no exception. She could make a mold, pull and pour a pot with rare taste and skill and sometimes found it necessary to do these things in the days following the death of her husband, when she found herself with a business on her hands. Instead of bewailing her fate and searching in vain for some male relative willing and competent to operate the establishment, she kilted her petticoat, figuratively—and sometimes literally—and ran the business herself until her son Thomas W., was old enough to assume the burden.

Owing to the prejudice which existed at that time against women entering the business field, Mrs. Williams prudently concealed her identity and simply signed her initials E. A., instead of her given name to all contracts and business correspondence. As a natural consequence the firm became known as E. A. Williams & Son.

The present president and general manager is a university graduate; but he also is a practical molder and melter with first hand knowledge gained in his younger days in the old shop under his father's direction. His time principally is taken up with the problems incident to keeping the Jersey City shop and second shop in Elizabeth, filled to capacity, but he finds time each day to confer with his old Welsh foreman on many of the intimate details of molding and melting involved in the production of the miscellaneous line of castings handled by the company particularly in the Jersey City plant.

Government Work

In the early days, particularly during the civil war, the foundry was employed almost exclusively on government contracts and among other jobs furnished the bronze castings for the MONITOR, built across the bay in a Brooklyn yard by John



Left—Pots Are Lifted By a Power Hoist. Right—Mechanical Equipment Aids Operations in the Elizabeth Plant

Cleaning Equipment, Saws, Sprue Cutters and Grinders are Concentrated Near the Shipping Door of the Plant Operated by the Company in the City of Elizabeth

Ericsson. During the recent war, practically the entire capacity of the foundry was devoted to the production of war materials. In the years between, the government, particularly the navy department has been an important customer. In fact it is claimed nearly every boat in the United States navy carries some castings made in this foundry.

Technical and practical knowledge of the foundry staff was placed freely at the disposal of the government during the war. T. H. Williams frequently was called to Washington by Franklin D. Roosevelt, secretary of the navy in president Wilson's cabinet. On one of these occasions he wrote the set of specifications which have been adopted as standard for all bells coming under the jurisdiction of the navy department afloat and ashore. The nucleus of the first ordnance company that went to France to take charge of foundry and forge work was recruited in Williams' foundry and captained by the late treasurer of the company Wallace H. Linn who died a few years later from the after effects of his service with this section of the American expeditionary force.

In the years of peace, the reputation of the foundry attracted orders from widely diversified sources. Castings for several of the cup defenders which upheld America's supremacy on the high seas were made here. Other castings were made for the Holland submarine; one of the first air ships; the Carnegie, the only nonmagnetic ship in existence; all the lock gates for the original Morris and Essex canal and some if not all the gates for the Erie canal. So far as available records show this was the first jobbing shop in which aluminum was cast commercially at a time when the metal was little known and sold for $5 a pound.

With all this background of tradition it is not surprising to find that the company has well defined standards by which its policy is guided in practically every respect. For example a price that will yield a profit is placed on every casting. If a prospective customer thinks the price is too high, the cards are laid upon the table and he is shown the factors on which the price is based. The price sometimes hinges on the market val-

The Melter Tries the Temperature of the Metal Before Removing It from the Furnace, Coal for the Furnaces Is Measured in the Riddles at the Right

Above—Part of the Main Foundry Floor at the Elizabeth Shop

Below—One of the Testimonials of Valued Wartime Service

We know of no other Foundry Record
Equal to this

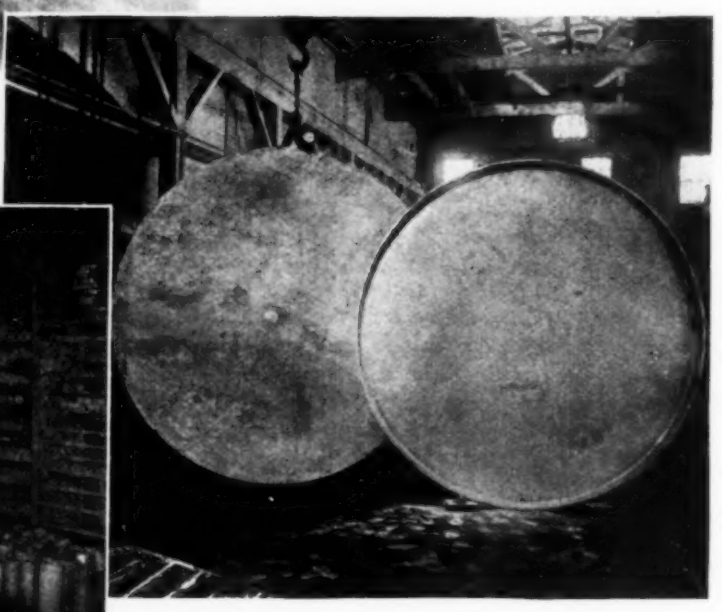
During the War
E. A. Williams & Son, Inc.
made for the U.S. Navy over 250,000 Pounds of castings as shown in above photograph. Every one of these had to pass the following Govt. inspections:

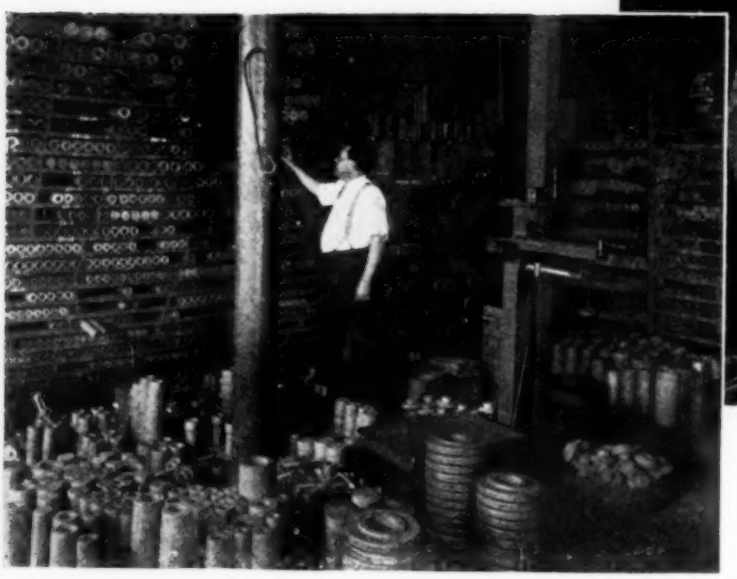
Hydrostatic Tests (soundness)
Physical " (strength)
Analytical " (uniformity of metal)

Every Pound Passed Perfectly.

Above—A Complete Machine Shop for Finishing Cast Parts Is Maintained at Elizabeth

Below—Thin Aluminum Castings Have Been Made up to 8 Feet in Diameter





Left—Part of the 30,000-Pound Stock of Cored and Solid Bars from which Shipment May Be Made Daily

ue of nonferrous metals either in ingot or scrap form. In many of these instances Mr. Williams' expert knowledge of alloys convinces the customer of the justice of the demanded price. No attempt is made to meet cut price competition. Most of the castings made in the Jersey City plant are made for exacting customers. They want just exactly what they want and they are willing to pay for it.

Repetition Work

Orders are taken for single castings and for small numbers and for that reason it is essential that the castings be made by highly skilled men and that the metal mixtures be made by men who are familiar with all the details of the process. Molding and pouring are done by hand and the metal is melted in crucibles in coal-fired, pit furnaces. A proper craftsman's pride permeates the establishment from the front office to the shipping department in carrying out difficult assignments, particularly in making castings that have been refused or given up after unsuccessful trials by other foundries.

Plain castings in small numbers and both plain and intricate castings in large numbers are made in a second shop operated by the company in Elizabeth, N. J. This shop is modern in every detail, fully equipped with molding machines and other forms of mechanical equipment and designed especially for the production of repetition castings in large numbers. Patterns are mounted on matchboards and stripping plates, molds are stacked in rows, standardized mixtures are melted on regular schedule and a monorail system and air hoists facilitate the movement of all materials including molten metal. It is operated on a mechanical production basis and in that respect is typical of the modern trend of the foundry industry along mass production lines. It is highly efficient, but presents none of the picturesque features which characterize the Jersey City plant in which the success of the castings depends almost exclusively on the manual skill of the molder coupled with his intimate knowledge of all the tricks of the trade. Scientific metallurgical knowledge and equipment are supplemented by a foundry sixth sense of temperatures and appearances of metal gained over a long period of intense application.

New accounts are not refused, but the policy of the company so far as possible is to retain the business of steady customers. Aside from the sentiment involved, this class of trade is the more profitable. In this connection it is interesting to note that some customers have been drawing their supplies of castings from this foundry for over 30 years. Naturally, contacts of this kind help to develop an intimacy of human relationship and this relationship in turn acts as a lubricant on the wheels of business and as a buffer to the inevitable minor collisions that arise from time to time.

As a promoter of intimacy and a tangible bond of good fellowship between producer and consumer, the company issues a four page 7 x 8-inch bulletin every month and distributes it among its customers. The front cover carries the title *Brass Foundry Facts* and the name and address of the company. The material on the inside is written by the president Thomas H. Williams and may take any form from an essay on Christmas to a technical description of nonferrous alloys.

Albany molding sand, a grade or two coarser than usually employed in brass foundries is used in the Jersey City plant. This sand may be rammed harder than a finer sand and consequently the resulting castings conform more truly to the shape of the pattern. Also it is a fairly reliable insurance against cuts, scabs, blisters and blowholes in the castings. Although it is rammed hard it remains sufficiently porous to facilitate the escape of steam and gas generated when the mold is filled with molten metal.

Bushings Stocked

Metal is melted in crucibles in natural draft pit furnaces fired with anthracite coal. Many advantages are claimed for this method of melting the metal. Probably the greatest advantage is its extreme flexibility by which a great many mixtures, if necessary, may be melted simultaneously to pour a wide variety of castings on any given occasion. Conversely, should conditions be reversed the entire battery of crucibles may be charged with the same mixture.

In addition to the wide range of miscellaneous castings the company specializes in the manufacture of 80-10-10 phosphor bronze bearings. An immense stock constantly is kept on hand for prompt shipment of any reasonable quantity in any of the 300 sizes. Molds for these castings are made horizontally from split patterns and poured on an incline to prevent bending the dried oil sand core in the center. The larger sizes are poured at the bottom in a vertical position.

Close supervision is kept over all the materials entering into the manufacture of the castings. Virgin metal and ingot metal are bought to analysis and specification. Scrap metal only is bought after personal examination. A slight premium is paid the dealer for the privilege of selecting some of the scrap and rejecting the remainder in any given collection.

New and old metal are stored according to classification in a number of bins in a room provided with a scale and adjoining the melting department. Here the charges are made up to meet the requirements of the day as represented on the molding floor. Relic of the old days when the shop was located close to the river and when petty larceny and pilfering was carried on extensively by individuals and organized bands is found in the heavy wire grating which still protects the skylights and the windows of the building.

Consolidate Interests

The Blaw-Knox Co., Pittsburgh, with plants at Blawnox, Pa. and Baltimore, Md., has purchased the Milliken Bros. Mfg. Co., New York. The consolidation of the two companies will become effective Sept. 1.

The Blaw-Knox Co. manufactures a diversified line of steel specialties, including steel forms for concrete construction, steel buildings, open-hearth furnace equipment, air preheaters, hammer welded products, steel transmission towers, automatic concrete measuring devices, steel bins, chamshell buckets, etc.

The Milliken Bros. Mfg. Co. originally was organized as Milliken Bros. Inc. in 1857. Its products consist of transmission towers, radio towers, and standard steel buildings. A portion of its business has been in the export field, and the present Milliken organization will continue to function in this field and in addition will take over the management of the export business of the Blaw-Knox Co. on all of its products. The latter company will continue with its present organization to handle domestic business, and the acquisition of the Milliken company will make no change in this line. Manufacturing for both companies will be concentrated at the Blaw-Knox Co. plants at Pittsburgh and Baltimore.

J. W. Marshall, formerly with Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed advertising manager of the Quigley Furnace Specialties Co. Inc., New York.

Electric Annealing Furnace *Is* Controlled Automatically

By Edwin Bremer

This is the second and concluding article describing a modern electric steel foundry. The melting of metal and also the annealing of the castings is accomplished in electrical furnaces.

LADLES used in pouring steel at the Burnside Steel Foundry Co., Chicago, are the tea-pot spout type. The large 4-ton bull ladle uses a hollow silica tile for the spout. It has been found that the cost of using this hollow tile cuts down the cost of lining to a considerable degree and better service also is obtained. At the right in Fig. 2 may be seen the small pouring ladle, heating and drying furnace. The furnace is constructed of firebrick and has 6 openings over which the ladles are inverted. The furnace is fired by an oil burner operating under a 4-ounce pressure supplied by a blower. Both burner and blower are manufactured by the Mahr Mfg. Co., Minneapolis. Oil for the various burners used throughout the shop is stored in two tanks. One has a capacity of 10,000 gallons and is housed in a brick and concrete building above ground. A 12,000 gallon underground tank is used for storage purposes and oil from this tank is pumped to the 10,000 gallon service tank when needed.

To permit the use of as cheap a grade of fuel oil as possible, the 10,000 gallon tank is equipped with a 20-kilowatt electric heater that has the capacity of heating 250 gallons of oil an hour, and is automatically regulated. At present the oil feeder system is being reconstructed under the

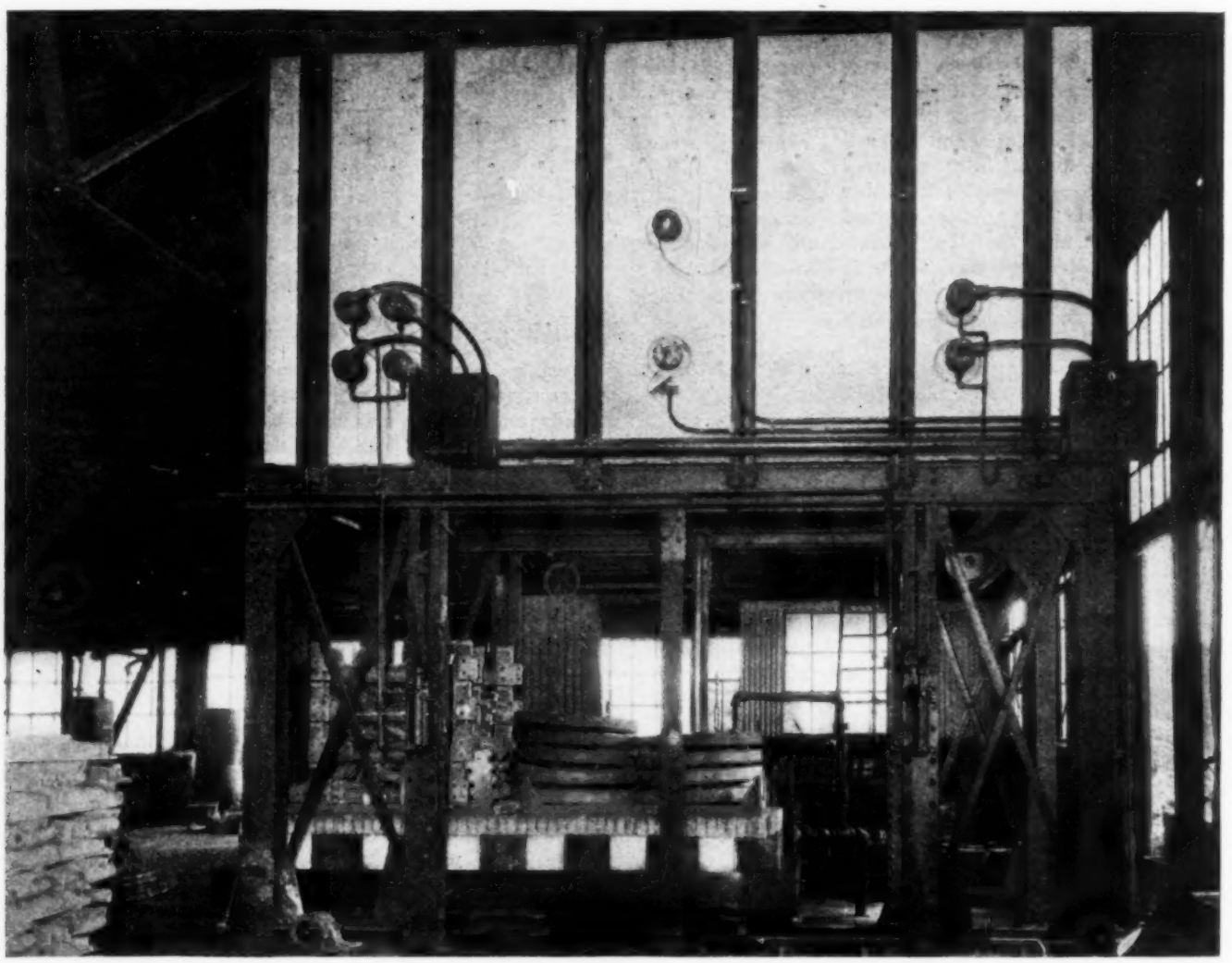


Fig. 8—The Electric Annealing Oven Is Placed Above the Floor Level. During Operation a Free Passage Is Left Under the Furnace

direction of L. M. Bassini, general manager, into a continuous circulation system. When this system is completed a pump will keep the oil circulating from the tank through the piping system and back to the tank continuously. In this way each burner will be supplied with oil of the proper temperature and fluidity.

Sand cutting is done at night with a sand cutter manufactured by the American Foundry Equipment Co., Mishawaka, Ind. Facing sand for the molds is mixed in a pan-type mill manufactured by the National Engineering Co., Chicago. This muller is one of the small types and to maintain an adequate supply of facing sand the mill is operated 15 or 16 hours a day. All castings are made in green sand molds made from silica sand bonded with a mineral bond manufactured by the Owyhee Chemical Products Co., Chicago.

After the steel is tapped into the 4-ton ladle as shown in Fig. 1, the ladle is carried by the crane to that section of the shop where molds are to be filled. At that place the ladle is manoeuvered into position by the crane and placed on a trunnion support shown in Fig. 9. The molten metal is poured into the hand ladles and carried to the waiting molds as needed. The bench molding section and the heavy molding floors may be seen in the left background of Fig. 9.

As previously mentioned, the coreroom is situated in a building apart from the foundry and connected to it by a covered passage. Housed in the same building with the coreroom are the locker and wash rooms and the pattern shop as may be seen in Fig. 4. The coreroom occupies a space approximately 50 x 70 feet. Most of the cores are made by hand, but where the quantity warrants and the type of core permits a jolt squeezer molding machine manufactured by the Osborn Mfg. Co., Cleveland, and a molding machine manufactured by the International Molding Machine Co., Chicago, are used. Other machines for making certain types of cores also are included in the coreroom equipment. One machine makes round cores from ⅜-inch to 6-inch diameter and the other is a cutting off and coning machine. Both of these are manufactured by the Wadsworth Core Machine & Equipment Co., Akron, O.

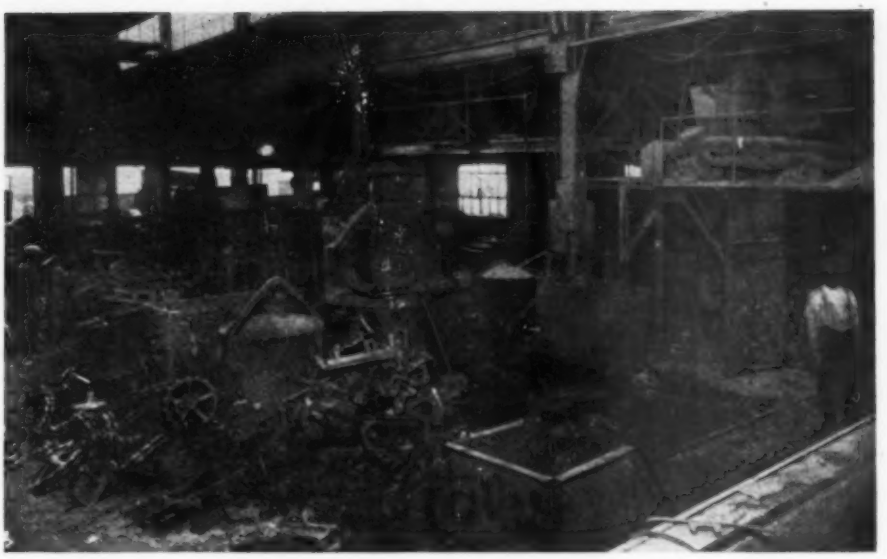


Fig. 10—View of the Cleaning Room Showing the Sandblast Machines

A rosin mill manufactured by the S. Obermayer Co., Chicago, is used to prepare rosin suitable for core mixtures. The sand for cores is mixed in a small sand mixer manufactured by the National Engineering Co., Chicago, or in a second mixer manufactured by the Standard Sand & Machine Co., Cleveland. Cores are baked in four, medium-size ovens of the Burnside company's own design and the ovens are arranged so that they may be fired either with coke or gas depending on circumstances.

The patternshop occupies a space about 30 x 40 feet and is equipped with machines of various types for pattern production. Steel beams are placed under the roof in such position as to form lumber storage racks which are out of the way in the shop. These racks will hold about a carload of lumber. Between the patternshop and the coreroom is a space 20 x 40 feet which is used as a locker and washroom for the employes. This room is equipped with lockers, washbowls and shower baths. Since the passage between the foundry and the coreroom is covered, there is no necessity for the men to go outside in going to and from the locker and washroom.

South of the heavy molding floor in the east bay is the cleaning room. Fig. 10 is a view looking south and shows the west side of the cleaning room occupied by the sandblast machines. One machine is that known as the room or chamber type and the other, the rotary table type. Both machines are manufactured by the Pangborn Corp., Hagerstown, Md. The

Fig. 9—Trunnions Support the 4-Ton Ladle as the Steel Is Poured into the Smaller Ladles Used on the Floors

Fig. 11—Tumbling Mills Are Placed on the Opposite Side of the Room

larger castings are loaded on a car and pushed into the room sandblast machine to be cleaned. The smaller and more easily handled castings are cleaned on the rotary table machine.

Sprues, heads and gates are removed from the castings by a sprue cutter manufactured by the Hanna Engineering Works, Chicago, and by oxy-acetylene torches. Grinding is done on a stationary grinding machne manufactured by the Norton Co., Worcester, Mass., a machine manufactured by the Pittsburgh Grinding Wheel Co., and a swing grinder manufactured by the Transmission Ball Bearing Co. Inc., Buffalo. The cleaning department also contains a 54-inch horizontal face grinder manufactured by the Charles H. Besly & Co., Chicago, and a 36-inch vertical disk grinder manufactured by the Gardner Machine Co., Beloit, Wis. A 50-ton hydraulic straightening press manufactured by the Lucas Machine Co., Cleveland, is used in straightening castings that have become bent or warped.

Fig. 11 is a view looking north in the cleaning shop and shows a portion of the east side of the building. The arrangement of the tumbling mills plainly can be seen. The mills used are manufactured by the Whiting Corp., Harvey, Ill., and by the W. W. Sly Mfg. Co., Cleveland. Gears on the mills are protected by suitable guards. Rails built of pipe and wood are across the ends of the tumbling mills which are arranged in pairs, to prevent accidents. A chain is placed across the front of the barrels when they are in operation.

Along the same side of the building as the tumbling barrels are the electric welding machines of which there are four. Each machine is enclosed in a small room with walls about 6 feet high. These rooms are constructed of corrugated steel sheets and prevent the strong light rays from the welding arcs being visible in other parts of the adjoining shops.

A small machine shop also is included in the layout of the Burnside Steel Foundry Co. This machine shop contains enough equipment to make repairs on the various machines and equipment used in the plant. Two air compressors which supply compressed air for the operation of machines in the foundry also are located in the machine shop. One is a 450-cubic foot, compound compressor and the other a 1100-cubic foot, compound compressor. Both compressors were manufactured by the Sullivan Machinery Co., Chicago. The switch board with its controlling switches and recording devices is placed in a small room adjoining the machine shop. One of the recording devices contains a duplicate tape on which the demand rate of the electric furnace is traced. This tape is used to check the charges of the Commonwealth-Edison Electric Co., Chicago, which supplies power to the plant.

Annealing of castings to obtain the best physical properties is an important operation in any steel foundry. It has been suggested that the term heat treatment be substituted for annealing because the process involves more than a mere heating to a red heat and cooling which is understood to be annealing. The process used in treating steel castings no longer is a hit or miss procedure, but is the result of numerous experiments and investigations whereby it was found that heating the castings to a certain temperature and maintaining this for a certain definite period brought about definite changes in structure. These changes in structure improved the physical properties of steel to a considerable extent.

Fig. 12—Brick Building With Steel Racks Is Used for Pattern Storage

A novel type of heat treating furnace designed and erected by William Swindell & Bros., Pittsburgh, is used by the Burnside Steel Foundry Co., in treating its steel castings. This furnace is electrically heated and is 350 kilowatt capacity. As may be seen in Fig. 8, the furnace is mounted about 10 feet above the floor on a suitably constructed steel structure. The car shown in the illustration forms the bottom which also is the door of the furnace. About 12 inches of insulating material covers the frame immediately over the top of the car, and a layer of firebrick placed on edge and cemented in place covers the insulating material.

As may be seen in Fig. 8, the castings are placed upon the brick flooring. The sides of the car are turned up to form a rectangular cup which is partly filled with sand and when the car is raised to the furnace, forms a sand seal. This sand seal effectively prevents the escape of any heat from the furnace which also is well insulated. The door of the furnace is raised into position by an oil-operated hydraulic elevator manufactured by the Otis Elevator Co., New York. A hydraulic pump manufactured by the Worthington Pump & Machinery Corp., New York, supplies the necessary operating oil pressure.

After the bottom door is raised to the necessary height it is held in place by heavy steel dogs operated by oil pistons. The dogs and pistons may be seen in the released position on two of the furnace supporting columns in Fig. 8. When the holding dogs are in position, the elevator is allowed to descend to the floor level which leaves a clear passage upon which materials may be transported out of or into the plant at this point. Another advantageous feature of this arrangement is that the carload of hot castings when removed from the furnace may be shoved outside of the building until cool enough to handle.

The cars have a capacity from 2 to 6 tons depending on the size of the castings. The castings are heated to 1650 degrees Fahr. and this temperature is maintained for 10 hours. Temperature of the heat treating furnace is automatically controlled by instruments manufactured by the Leeds-Northrup Co., Philadelphia. L. M. Bassini, general manager, Burnside Steel Foundry Co., states that the bottom seal arrangement of the heat treating furnace has reduced the scaling of castings during heat treatment to a low degree and pointed out a number of castings ready for shipment that had been removed from the furnace without any further finishing.

An adequate pattern storage department with the patterns so arranged that any particular one may be found quickly is a necessary adjunct to the modern jobbing foundry. A well lighted building of fireproof construction provides these facilities for the Burnside company. This building is about 75 x 75 feet, and the front portion facing on the street is occupied by the general office. The back portion of this building approximately 60 x 75 feet is devoted to the pattern receiving and pattern storage departments. The pattern storage department is separated from the other parts of the building by brick walls and iron doors which in event of fire should protect the patterns from damage. A view taken in one of the aisles of this department is shown in Fig. 12. Angle irons are used to form a substantial framework for the shelves. The shelves are formed of sheets of corrugated steel. Each section is numbered and as the patterns are received for storage, they are placed in a certain section the number of which is filed with a description of the pattern. Whenever a pattern is desired for use, it is an easy matter to locate it.

One feature used in this storage department that may be successfully employed in other similar departments of other plants, is the ladder used to gain access to the upper shelves. As may be noticed in Fig. 12, the ladder is mounted on wheels on the lower or floor end. The upper end is attached to a bar which is suspended from two travelling rollers or wheels, one on each side of the frames forming the aisle, which move in steel hangers. The suspension system is similar to that employed on store ladders or on sliding doors. The angle at which the ladder is inclined is such that it may be mounted without having to grasp the sides or rungs. The advantage of this may be seen when the pattern clerk has both hands or arms full of patterns and he has to climb up or down the ladder. The wheels at the bottom end allow the ladder to be moved easily even with a person on the ladder.

Makes Business Trip

Ernest V. Pannell, technical advisor, British Aluminum Co., New York, has gone to London, England, where he will spend two or three months on business.

Over eight and one quarter million stoves and ranges valued at $179,800,548 were produced in 1925 according to the United States bureau of census.

English Metallurgists Plan Fall Meeting

The autumn meeting of the Institute of Metals of London will be held at Derby from Sept. 6 to 9, under the direction of Sir Henry Fowler, vice president, and chief mechanical engineer of the London, Midland and Scottish railway company.

The sixth autumn lecture will be delivered on Tuesday evening, Sept. 6, in the Municipal Technical college, Derby, the subject being "Nonferrous Metals in Modern Transport" by Dr. L. Aitchison. On Sept. 7 and 8 the mornings will be devoted to papers, which will be presented in abstract and discussed. In the afternoons visits will be paid to the car and locomotive works of the London, Midland and Scottish railway company, the Derby Crown China works, the works of Rolls-Royce, Ltd., Leys Malleable Castings, Ltd., and the printing works of W. Bemrose & Sons, Ltd. On Friday, Sept. 9, an all-day excursion will be made by motor chars-a-bancs to the Peak district.

The following papers are expected to be submitted: "The Copper-Magnesium Alloys," by W. T. Cook and W. R. D. Jones; "Researches on Intermetallic Compounds. The Reaction between Solid Magnesium and Liquid Tin" by W. Hume-Rothery; "Age-Hardening Tests with Elektron Alloys" by K. L. Meissner; "The Equilibrium Diagram of Copper-Tin Alloys containg from 10 to 25 per cent of Tin" by A. R. Raper; "Note on Cathodic Disintegration as a Method of Etching Specimens for Metallography" by Cyril S. Smith; "The Protection of Aluminum and its Alloys against Corrosion" by H. Sutton and A. J. Sidery; "The Nature of the Film Produced by Anodic Oxidation of Aluminum" by H. Sutton and J. W. W. Willstrop; "Grain Growth in Compressed Metal Powder" by C. J. Smithells, W. R. Pitkin and J. W. Avery; "The Undercooling of Some Aluminum Alloys" by Marie L. V. Gayler; "The Constitution of Alloys of Aluminum with Silicon and Iron" by A. G. C. Gwyer and H. W. L. Phillips; "Effect of Work and Annealing on the Lead-Tin Eutectic" by F. Hargreaves; "The System Magnesium-Cadmium" by W. Hume-Rothery and S. W. Rowell; "The Constitution and Physical Properties of Some of the Alloys of Copper, Zinc and Cadmium."

Ingersoll-Rand Co., New York, has opened a branch office at 236 High street, Newark, N. J., in charge of F. K. Armstrong.

Caring for Motor Insulation

Suitable Lubrication, Proper Drying of Damp Windings, Making Resistance Tests and Frequent Inspection and Cleaning, Are Necessary in Prolonging Life of Electric Motors

By C. W. Falls

MODERN methods of design and construction have made the electric motor one of the least complicated, and most dependable, forms of machinery in existence. Therefore its maintenance is of comparative simplicity. However, this statement should not be taken to mean that proper maintenance is not important. On the contrary, it must be given careful consideration if the best performance and longest life is to be expected from the motor.

The two major features, from the standpoint of their effect upon the general performance of the motor, are those of proper lubrication and the care given to the insulation because they concern the most vital parts of the machine. The former will be discussed here only with regard to its relation to the maintenance of the insulation.

Lubrication Is Important

The designs of bearings and bearing housings of motors have been improved wonderfully in the last few years. The point has now been reached where bearings of modern motors, whether sleeve, ball, or roller, require only infrequent attention.

This advance in the art is not yet fully appreciated, for oiling and greasing of new motors often is entrusted to uninformed and careless attendants, with the result that oil or grease is copiously and frequently applied to the outside as well as the inside of bearing housings. Some of the excess lubricant is carried into the machine and lodges on the windings, where it catches dirt and thereby helps in the ultimate failure of the insulation.

The modern designs provide for a plentiful supply of oil or grease being held in dust-tight and oil-tight housings. If the proper amount of a suitable lubricant is applied before starting, there should be no need to refill the housings for several months, even in dusty places. Infrequent though periodic and reasonable attention to modern bearings of any type will tend toward longer life of both bearings and insulation.

Motors should be stored in a dry, clean place until ready for installation. Heat should be supplied, especially for larger high-voltage machines, to protect against alternate freezing and thawing. This is equally applicable to spare coils.

Motors that have been long in transit in moist atmosphere, or have been idle for an extended period without heat to prevent the accumulation of moisture, should be thoroughly dried out before being placed in service. Machines may also become wet by accident, or they may "sweat" as a result of a difference in their temperature and that of the surrounding air, just as cold water pipes "sweat" in a warm, humid atmosphere. This condition is injurious and should be prevented, particularly in the case of large or important motors, by keeping them slightly warm at all times. Current at a low voltage can be passed through the windings, electric heaters can be used, or even steam pipes may be utilized for protective purposes. In the case of extended idle periods, tarpaulins may be stretched over the motor and a small heater put inside to maintain the proper temperature.

If a motor has become wet from any cause whatever, it should be dried out thoroughly before being operated again. The most effective method is to pass current through the windings, using a voltage low enough to be safe for the winding in its moist condition. For 2200-volt motors, 220 volts is usually satisfactory for circulating this drying-out current. Thermometers should be placed on the windings to see that they are being heated uniformly. Temperatures should not exceed 90 degrees Cent. (Class A insulation.) Applying the heat internally in this manner drives out all moisture, and is particularly effective on high-voltage motors, where the insulation is comparatively thick.

Heat Applied Externally

Heat may be applied externally by placing heating units around or in the machine, covering the whole with canvas or other covering, and leaving a hole at the top to permit the escape of moisture. In doing this, it is essential that there be a circulation of warm air over all the surfaces to be dried. The air should be allowed to escape as soon as it has absorbed moisture. Therefore, the heaters should be so placed and baffles so arranged as to get a natural draft; or small fans may be used to force circulation. Twelve-inch fans set to blow air across the fronts of "glow heaters" and then into the lower part of a machine from opposite sides, and so on up around the windings and out the top, will produce surprising results. The temperature of the winding should not be allowed to exceed 100 degrees Cent. for Class A insulated motors. Smaller machines may conveniently be placed in ovens, the same temperature limits being observed.

The time required for complete drying-out depends considerably on the size and voltage of the motor. Insulation resistance measurements should be taken at intervals of four or five hours until a fairly constant value

Systematic Attention Prolongs Life

PERHAPS no unit of industrial equipment is more widely used or is subjected to more continuous service than the electric motor. In this age of electrification, it would be difficult to find a manufacturing establishment of ordinary size or importance that does not rely on one or more motors.

The reliability of these units serves to obscure the necessity of proper maintenance. While most motors will give exceptional performance even when seriously neglected, their efficiency can be considerably increased and their life measurably prolonged if the procedure outlined in the accompanying article is followed.

The article is reprinted by permission from the August number of the General Electric Review. The author, C. W. Falls, is in the industrial engineering department of the General Electric Co., Schenectady, N. Y.

is reached. This value should at least equal the recommended A.I.E.E. standard, which is

$$\text{Megohms} = \frac{\text{Voltage}}{\text{Kv-a.} + 1000}$$

The insulation resistance of dry motors in good condition is considerably higher than this value.

The more convenient way to measure this resistance is through the use of a "Megger," although if a 500-volt direct current source is available, readings can be taken with a voltmeter. The ungrounded side of the system should be connected to all the motor terminals through the voltmeter, the opposite or grounded side being connected directly to the motor frame. The insulation resistance is found by

$$R = r \left(\frac{E}{V} - 1 \right)$$

where R = insulation resistance in ohms

E = line voltage (d-c.)

V = voltmeter reading

In using the voltmeter method the connection to the frame should always be made through a fuse of not more than 10 amperes in size. The circuit should be tested and the side showing a complete or partial ground then connected to the frame through the fuse.

Obviously the insulation resistance varies over a wide range, depending upon moisture, temperature, cleanliness, etc., but it is a good indication of the general condition of the insulation and its ability to stand the operating voltage. Such readings should be taken before a high-potential test, to determine whether the insulation is ready for such a test, and afterward to make sure that the high potential has not injured the insulation.

High-potential tests should be made after drying out, or after repairs, to determine the dielectric strength of the insulation. New windings should successfully stand a high-potential test of twice normal voltage plus 1000. There is some disagreement as to the proper value to use for motors that have been in operation for some time, but it is reasonable to assume that, *after thorough cleaning and drying*, the winding of a used motor should stand 150 per cent of normal voltage for one minute.

Small high-potential testing sets are available for such work and are of such capacity that very little damage will result from a breakdown during the test.

Periodic Inspection Necessary

A systematic and periodic inspection of motors is necessary to insure best operation. Of course, some machines are installed where conditions are ideal, where dust, dirt, and moisture are not present to an appreciable degree; but most motors are located where some sort of dirt accumulates in the windings, lowering the insulation resistance and cutting down creepage distances. Steel mill dusts are usually highly conductive, if not abrasive, and lessen creepage distances. Other dusts are highly abrasive and actually cut the insulation in being carried through by the ventilating air. Fine cast-iron dust quickly penetrates most insulating materials. Hence the desirability of cleaning the motors periodically. If conditions are extremely severe, open motors might require a certain amount of cleaning each day. For less severe conditions weekly inspection and partial cleaning is desirable. Most machines require a complete overhauling and thorough cleaning about once a year.

For the weekly cleaning the motor should be blown out, using moderate pressure, dry, compressed air (of about 25 to 30 pounds per square inch pressure). Where conducting and abrasive dusts are present, even lower pressure may be necessary, and suction is to be preferred, as damage can easily be caused by blowing the dust and metal chips into the insulation. On most direct current motors and large alternating current motors the windings are usually fairly accessible, and the air can be properly directed to prevent such damage.

On the larger alternating current machines, the air ducts should be blown out so that the ventilating air can pass through as intended.

On large machines, insulation resistance readings should be taken in the manner indicated earlier in this article. As long as the readings are consistent the condition of the insulation would ordinarily be considered good. Low readings would indicate increased current leakage to ground, or to other conductors, owing to one of perhaps several causes, such as deteriorated insulation, moisture, dirty or corroded terminals, etc.

About once a year, or oftener if conditions warrant, motors should be overhauled. Smaller motors, the windings of which are not particularly accessible, should be taken apart.

First, the heavy dirt and grease should be removed with a heavy, stiff brush, wooden or fiber scrapers, and cloths. Rifle-cleaning bristle brushes can be used in the air ducts. Dry dust and dirt may be blown off, using *dry* compressed air of 25 to 30 pound pressure, taking care to blow the dirt out from the winding. As stated before, if the dirt and dust is metallic, conducting, or abrasive, air pressure may drive the material into the insulation and damage it. Hence, for such conditions, pressure is not so satisfactory as a suction system. If compressed air at low pressure is used, care must be taken to properly direct it so that the dust will not cause damage and will not be pocketed in the various corners.

Grease, oil, and sticky dirt are easily removed by applying cleaning liquids like carbon tetrachloride, gasoline, or naphtha. All of these liquids evaporate quickly and, if not ap-

Rules for Maintenance of Motor Insulation

1. When oiling or greasing bearings, be sure excess lubricant does not get into windings.

2. When motors are in transit, in storage or idle for an extended period, protect them against moisture and dust.

3. If a motor has become damp, dry it out before operating it.

4. After drying a damp motor, test it for insulation resistance and then subject it to the high-potential test.

5. Maintain a system of periodic inspection of all motors. Weekly inspection and partial cleaning is recommended for motors in average service.

6. Give every motor a thorough cleaning once a year, or oftener if conditions warrant.

7. If an inflammable cleaning liquid is used, guard against the accumulation of explosive vapors in pits and basements.

plied too generously, will not soak or injure the insulation. Carbon tetrachloride is best and is recommended because it is non-inflammable.

In case one of the other liquids must be used, it should be applied out of doors or in a well-ventilated room. It must be remembered that gasoline or naphtha vapor is heavier than air and will flow into pits, basements, etc., and may remain there for hours or even days. The casual smoker, a spark from a hammer or chisel, or even from a shoe nail may cause a serious explosion. Therefore, proper ventilation of the room is essential and may require specially piped ventilating fans. In using carbon tetrachloride the explosion hazard is eliminated, but some ventilation is required to remove the vapor, which might affect the safety and comfort of the workmen.

There are several good methods of applying the cleansing liquid. A cloth, saturated in the liquid, may be used to wipe the coils. A paint brush, dipped in carbon tetrachloride, is handy to get into corners and crevices, and between small coils. Care should be taken not to soak the insulation as would be the case if coils or small machines were dipped into the liquid.

Probably the best method of applying the liquid is to spray it on. A spray gun, paint spraying appliance, or an ordinary blow torch are often used with good results, although the latter device is apt to give a heavier spray than desirable.

An atomizer will give excellent results, using a pressure of about 80 pounds if the insulation is in good condition, or 40 to 50 pounds if the insulation is old. The atomizer should be held not more than 5 or 6 inches away from the coils.

While the insulation will dry quickly at ordinary room temperature after such cleaning methods, it is highly desirable to heat it to drive off all moisture before applying varnish.

If the motor can be spared from service long enough, the insulation should be dried out by heating to from 90 to 100 degrees Cent. While warm, a high-grade insulating varnish should be applied. For severe acid, alkali, or moisture conditions, a black plastic baking varnish is best, while for conditions where oil or dusts are present, a clear or yellow varnish should be used.

The varnish may be sprayed or brushed on. For small stators or rotors, it is best to dip the windings into the varnish, cleaning off the adjacent metal parts afterwards by using a solvent of the varnish. After applying the varnish, the best results are obtained by baking for 6 to 7 hours at about 100 degrees Cent.

If the machine must be put back in service quickly, or if facilities are not available for baking, fairly good results will be obtained by applying one of the quick-drying black or clear varnishes which dry in a few hours.

Insulation resistance readings should be taken, as explained previously, to determine whether the winding is in satisfactory condition for applying a high-potential test. After this test, it is good practice to run the motor without load for a short time, to make certain that everything has been connected, assembled, and adjusted properly.

Foundrymen Will Meet in Paris

The program of the congress of the Association Technique de Fonderie de Paris, to be held in Paris Sept. 6 to 10, contains many items of interest. This congress will be held in conjunction with an international foundry exhibition at the exhibition grounds in Paris, and it is expected that visitors from many countries will attend. In view of this, special meetings and luncheons have been arranged for foreign visitors. Discussions will take place in English, Czech, German and Spanish.

On Sept. 7 a German session will be held in addition to the ordinary session. These meetings will be followed by a luncheon offered to the representatives of foreign foundry associations and the authors of exchange papers. Two professional luncheons also will be held, one group discussing light alloy castings, the other bronze castings. The exhibition will be visited in the afternoon.

Three separate sessions will be held on Thursday morning. One will be devoted to cast iron and the testing of iron castings, the second to production costs, and the third to the discussion of papers in the English language. On the same day there will be three luncheons, at which the following subjects will be discussed: High-quality and heat-treated cast iron, steel and malleable cast iron. The third luncheon will gather the English speaking delegates. In the afternoon the Ecole Supérieure de Fonderie will be officially inaugurated and Professor Portevin will deliver a lecture in the new amphitheatre on the applications of macrography. Following the lecture the laboratories of the school will be visited by the delegates attending the convention.

Three sessions will be held on Sept. 9. One will be devoted to cast iron, the testing of castings, steel and malleable cast iron. The second to bronze and light alloy castings, and in the third to discussions in Spanish. At luncheon the delegates again will be assembled in three different groups. Education and apprenticeship will be discussed by one group; while the remaining two groups will be for delegates speaking the English and Spanish languages. The afternoon will be devoted to plant visitation.

On Sept. 10 the congress will be officially closed and there will be two luncheons, one grouping the German speaking delegates and the other the delegates from Czecho-Slovakia. In the afternoon more plants will be visited, and the annual banquet will take place in the evening. Following the congress in Paris an organized tour of the foundry districts of northern France will be held. On Monday, Sept. 12, the delegates will visit foundries in the regions of Laon, Guise, Hirson and Valenciennes. On Sept. 13 the Aciéries de Denain Anzin and the works of Société Fse. de Constructions Mécaniques (Anciens Etablissements Cail) will be visited in the morning. In the afternoon the delegates will travel back to Valenciennes and then to Lille, and on Wednesday, Sept. 14, plants will be visited in the manufacturing district of Lille.

Welders Will Meet

The fall meeting of the American Welding society will be held at Detroit, Sept. 19 to 23. In addition to the usual technical sessions, a number of inspection tours have been arranged. A welding and cutting exposition will be held in conjunction with the National Machine and Tool exhibit.

Purchases Brush Firm

Osborn Mfg. Co., Cleveland has purchased the Rubico Brush Manufacturers, Inc., New York, maker of paint brushes. I. A. Rubin, founder of the business, will remain as president in charge of operation. Earl W. Cammell, Osborn Mfg. Co., has been elected secretary and assistant manager.

William E. Brown, manager of the central station department, New York district, General Electric Co., Schenectady, N. Y., has been appointed New York district sales manager of the firm with headquarters at 120 Broadway, New York.

Specifications Are Worth While

Describes Reasons for Adopting Definite Core Oil Requirements—Gives List of Physical and Chemical Tests Which Insure Satisfactory Service in the Foundry

By V. A. Crosby

THIS paper is written from the production foundry viewpoint, and with little or no regard to the manufacturing problems of compounding the oil. Neither the writer nor any of his associates are core oil experts. It is hoped that the presentation of our method of securing uniform core oil without resorting to trade names may be of interest.

Probably less has been written about core oil and core binders than any other material used in the foundry industry. This is not at all peculiar if one considers that technical men in the foundry are comparatively rare, and that little thought was given to the idea of determining relative quality of these materials until the past few years.

H. L. Campbell, University of Michigan, made quite a study of commercial core oils along with linseed oil. I was disappointed to note in Table I of his paper that samples *E*, *O* and *R* show abnormal analyses. The conclusion at which he arrived is not surprising considering the material with which he had to work. Data from the table are shown in the accompanying Table I.

Quite obviously these analyses are wrong and the iodine numbers are high. We have had a few samples of rosin run up as high as 265 iodine value and the highest value on any drying oil was a sample of raw Perilla oil at 208.

Degree of unsaturation in oil can be measured directly by iodine absorption, therefore, the iodine value indicates directly its drying potentiality. From this, the importance of iodine value in drying oils becomes evident. Table II gives iodine numbers of the most important industrial drying and semi-drying oils.

Table III illustrates, to a degree, how iodine absorption, breaking strength and price go together. The prices of these oils are from high to low as shown by the numbers of the oils in Table III.

Following careful and complete chemical and physical analyses of core oils for a period extending over two years, we evolved a chemical specification for core oil which has been in effect about one year. We do not insist on a special core oil, nor one with peculiar merit, but we do know that if the oil meets our specifications we will have no trouble with its use, regardless of who makes it, or from whence it comes. The specification is given in Table IV.

The purchaser reserves the right to subject each shipment when received to these inspections and tests. Failure to pass any of them may be cause for the return of the shipment for full credit plus carrying charges both ways.

This core oil may, or may not, be the best oil possible to buy for the money; but we know it is a high grade oil, and that it gives perfect satisfaction in workability in the core boxes, quick baking time, thoroughness with which chunk cores are baked, and a minimum amount of obnoxious odors during the baking of cores and pouring of castings. Core sand mixtures running 120 to 1 speak for themselves so far as strength is concerned.

We specify gravity because it is one way to hold the rosin content down. We mention flash and fire point because we desire a kerosene mineral oil or light furnace oil. Someone may wonder if he could get by in using a paraffin oil or some heavy oil with a small amount of kerosene injected to get the flash and fire determination right. To this I would say, no one in the core oil business would be quite so foolish because kerosene is the cheapest clear mineral oil available.

The iodine number is mentioned because strength is the big factor and, along with other things mentioned in the specification, it is positively indicative. Saponification number indicates amount of animal oil or vegetable oil or both present. We specify acid number and watch it closely.

We have had complaints from oils which run higher than 41, also from some running much lower than 34. We think there is a happy medium in a compounded oil of this nature and we believe it is around where we have specified. Color is mentioned because it places all vendors on the same footing, in that they must use a clear oil and *H*-grade rosin. A dark oil would permit the use of cheaper rosin and linseed foots and cause stickiness

FROM a paper presented before a convention of the American Foundrymen's association, Chicago, June 6-10. The author V. A. Crosby has developed a set of physical and chemical specifications for all core oils which enter the plant with which he is connected. Experience has shown that oils which pass these tests, irrespective of their composition, will give satisfactory service in this particular foundry.

V. A. Crosby, technical director foundry operations, Studebaker Corp., South Bend, Ind., was born in Kosciusko, Miss., in 1893. He received his technical training at the University of Mississippi from which he was graduated with the degree of B. S. in 1916. Shortly after graduation he became a lieutenant in the United States army air service. Following his discharge after 16 months service he occupied several positions, chemist with Dodge Bros. and Portland Cement Co., chief chemist Briscoe Motor Co.. chief chemist, foundry metallurgist and chief metallurgist Packard Motor Car Co., Detroit, before he accepted his present position with the Studebaker Corp., South Bend, Ind., in 1921.

in the boxes. It is quite obvious to anyone why we object to a fishy odor.

We no longer make break tests to determine the value of a core oil. When all the errors encountered in making and baking briquettes are considered: dye absorption of the sand, grain size of the sand, mixing and ramming of the sand, ventilation and baking of cores, and temperature control of oven, it seems that the logical way out is to take the bull by the horns and do some real honest-to-goodness exact chemical analysis.

A core oil specification is just like a steel specification. You would not think of buying steel bars on a carbon specification alone, neither would I attempt to buy core oil on an iodine number alone, but as in steel, all points must be considered before arriving at a decision.

F. A. Smith, formerly assistant to the vice president, American Equipment Co., Mishawaka, Ind., has resigned to become associated with Sutor & Co., Los Angeles, Calif., dealers in foundry equipment and industrial machinery.

Table I

Samples Show Abnormal Analysis

Oil	Iodine No.	Unsaponifiable	Iodine No. of saponifiable matter would have to be:
E	123.5	70.33	401
O	151.0	71.50	520
R	157.0	54.30	370

Table II

Oils Entering Core Binder Mixtures

Oil	Iodine Number	Saponification No.
Perilla	199 to 208	189 to 194
Linseed	170 to 192	189 to 194
Chinawood	159 to 168	190 to 194
Menhaden	139 to 172	189 to 193
Sunflower	120 to 135	188 to 194
Poppy	134 to 152	190 to 197
Soya bean	122 to 130	190 to 193
Corn oil	121 to 131	189 to 192
Cotton seed	100 to 121	191 to 196
Rape seed	95 to 106	167 to 179
Mustard seed	96 to 122	172 to 180
Peanut	83 to 105	186 to 196
Sesame	103 to 117	188 to 193
Rosin	200 to 265	145 to 170

Table III

Relation of Break Test to Iodine Number

No.	Iodine No.	Break Test,* Pounds
1	173.2	303
2	167.0	292
3	155.1	266
4	144.2	232
5	132.4	230
6	125.5	168
7	113.0	140
8	97.0	101

*The break tests were made with Olsen automatic briquette testing machine. Briquettes were made by hand ramming—the same operator doing all ramming. The tests shown in the above table are averages of nine briquettes baked at 405 degrees Fahr. for 45 minutes at heat. Temperature variation being + to —5 of the desired temperature of 405 degrees Fahr. The mixture was 1000 grains Michigan City sand, 80 grains water, 14 grains oil. The average grain size of the sand was 70 mesh.

Table IV

Specification for Foundry Core Oil

Specific gravity	0.9310 maximum at 60 degrees Fahr.
Flash point	165 to 195 degrees Fahr.
Fire point	180 degrees Fahr. to 210 degrees Fahr.
Iodine number	155 minimum.
Saponification Number	148 minimum.
Acid Number	34 to 41.
Color	Light clear amber through half section.
Odor	Positively not fishy.
Gallonage	Shall consist of 231 cubic inches at 60 degrees Fahr. or actual weight per U. S. liquid gallon at 60 degrees Fahr.

Book Review

Fatigue of Metals, by H. F. Moore and J. B. Kommers, cloth, 326 pages, 6 x 9 inches, published by the McGraw-Hill Book Co. Inc., New York, and supplied by THE FOUNDRY for $4, postpaid, and in Europe by Penton Publishing Co. Ltd., Caxton House, London, for 20 shillings, net.

Growing use of high-speed machinery has increased the necessity for experimental knowledge of the behavior of materials, especially metals, under repeated stress. This volume, the first edition, is a summary of the more important facts concerning the strength of metals under repeated stress, a brief review of the more important of the current theories of fatigue of metals and a description of apparatus and methods used in making an experimental study of the fatigue of metals.

H. F. Moore is research professor of engineering materials, University of Illinois and J. B. Kommers is associate professor of mechanics, University of Wisconsin. Both are members of the American Society for Testing Materials and connected with joint investigation of the fatigue of metals.

In addition to metals consideration also is given to fatigue in wood and concrete.

In compiling tables of results of tests of various materials the authors have endeavored to make available, in compact and convenient form, typical results for various materials, giving in each case as complete a statement as possible of the chemical composition and heat treatment of each metal. The results quoted are based on tests covering a sufficient number of repetitions of stress to render results reliable.

The text is supplemented by plates, drawings, tables and an appendix contains a bibliography of wide inclusion. Author and subject indexes further assist the reader in his study.

Appointed Manager

H. B. Ackland has been appointed manager of the New York office, G. H. Williams Co., Erie, Pa., bucket manufacturer. Mr. Ackland succeeds E. L. Sparks and his headquarters will be at 30 Church street. C. F. Weiblen has been appointed factory representative in the Ohio district with headquarters in Cleveland.

H. C. Cornelison, manager, Miami, Fla., office, Austin Co., Cleveland, engineers and builders, has been placed in charge of the company's newly established office at Cincinnati.

Explains Brass Metallurgy-III

Large Quantities of Metal Are Produced Best in the Reverberatory Furnace—Electrically Heated Furnaces Avoid Some of the Difficulties Encountered in Other Types of Melting Units

By Edmund R. Thews

ONE of the most important points in the art of brass melting, which is not stressed nearly enough in literature, is the possibility of producing in the reverberatory furnace, large quantities of alloys of exactly the same composition and mechanical properties, a quality which in spite of the most careful operation, can never be attained by melting a large number of small charges. Homogeneity of the alloy is particularly important where large and heavy castings are to be produced or where the castings produced must be subjected to mechanical treatment. The impurities present as well as the melting and casting temperatures influence to a high degree the mechanical properties, hardness, tenacity, tensile strength, and elongation of the castings, thus modifying directly the method and the success of mechanical treatment achieved. Non-homogeneous material will lower the speed of operation and decrease materially the efficiency of the manufacturing process.

Produce Scrap

The influence of impurities upon brass alloys containing 67 to 65 per cent copper is much greater than with alloys richer in copper. Brittleness of brass in rolling caused by small contaminations with aluminum, arsenic, antimony, bismuth, cadmium, magnesium, phosphorus, silicon, and tin increases the nearer the composition of the alloys approaches the border line between workable and non-workable brasses.

Brasses with 64 to 63 per cent copper are straight *border alloys*. These alloys are not well suited for hot and cold rolling, and tend to produce much scrap. It should be mentioned however, that in spite of general opinion, there must be some methods of working these alloys also, since the author is aware of some German mills where the rolling of brasses with 63 plus or minus 1 per cent copper is practiced continually.

The group of alloys next in order, containing 62 to 60 per cent copper, if heated to temperatures above 600 degrees Cent. (1100 degrees Fahr.) contains sufficient beta-crystals to fit the material for any amount of hot working. These brasses are not composed of only one type of crystal but consist of a heterogeneous mixture of alpha and beta crystals. The latter are present in sufficiently large quantities to act as an alloying constituent, not as impurity as is the case with the presence of beta crystals in the alloys situated to the left of line b_2-b_3 in the copper-zinc diagram. It is clear, that alloys containing 62 to 60 per cent copper are much less sensitive toward the influence of impurities as the alloys previously mentioned, since any tendency to counteract the influence of copper in the alloy will result in the increased formation of the plastic beta-crystals.

This is the third and concluding article by Mr. Thews on the various features of brass and its metallurgy.

At ordinary temperatures the structure of brasses containing 62 to 60 per cent copper consists of a heterogeneous mixture of alpha crystals and brittle gamma crystals. The presence of the latter causes rapid embrittling of the material on cold working. Repeated annealings are necessary therefore, if these brasses are to be cold worked satisfactorily according to *Zeitschrift fur Metallkunde* Vol. 17, No. 10.

Must Be Treated Differently

It has been shown that a uniform treatment of differently constituted brass alloys, the copper contents of which may vary by 1 or 2 per cent only, is impossible as each alloy may require individual heat treatment. Even if the assortment of small lots of alloy produced is finally manufactured into the same articles, the mechanical properties of these will not be the same. Every practical foundryman knows that it is impossible under ordinary working condition to hit the exact composition of alloys aimed at, so that it is clear from the above deductions that wherever large quantities of brass alloys are to be produced for the same mechanical treatments it is often important to use melting devices able to put through charges of 15 to 30 tons of metal.

Quite frequently, difficulties are experienced in opening and closing the tap of large reverberatory furnaces. Instead of the ordinary tap flush with the hearth of the furnace, a slit tap or *American tap* should be applied to reverberatories of this type.

This tap consists of a slit 2½ inches wide, reaching from the hearth of the furnace up to about 2 inches above the usual surface line of the metal. This slit is closed with a tamped-in mixture of clay and powdered coke, which may be regulated so as to permit the metal to gradually cut its own path as the furnace is emptied. The flow of metal may be stopped at any time by placing a lump of wet clay into the channel cut by the metal, which, if necessary, is cleared and deepened with a steel rod at regular intervals.

Furnace Linings

Lining of hearth and walls is best made of silica bricks, although fireclay bricks are, perhaps, most widely used for this purpose. There can be no doubt that a good basic fire clay brick is as durable as any other kind of refractory bricks besides being considerably cheaper. Magnesite bricks, although rather useful on account of their chemical inertia towards the corrosive influences of metal and slag—a property of special importance in view of the strong solvent action of the soda ash mixture used for washing and fluxing—are not used as much.

Besides the comparatively high price of this refractory, the bricks are exceedingly sensitive toward rapid and abrupt temperature changes, spalling and chipping occurring easily. Bauxite and zirconia bricks also have been tried out lately. The results attained, while quite encouraging, as yet do not seem to justify the rather high cost of production.

Where charges of 1000 to 5000 pounds are the rule and electric power is expensive, large Continental foundries frequently are using tilting oil furnaces, flat round furnaces of an inside diameter of about 3 to 6 feet, heated by two burners. Besides short-

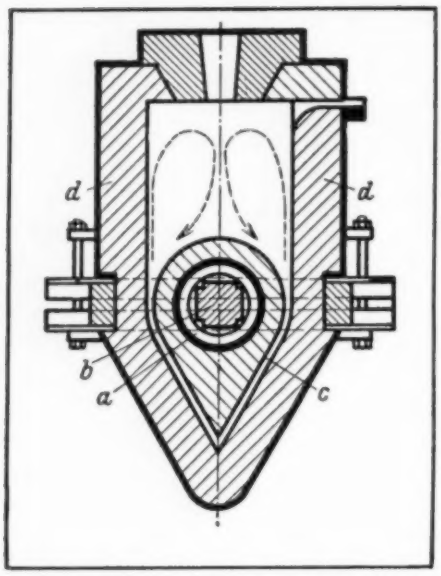


FIG. 4—INDUCTION TYPE BRASS MELTING FURNACE

ening the melting process considerably, these furnaces decrease the loss of zinc by oxidation to percentages not far above those attained with the electric induction furnace.

Working methods used in the reverberatory and tilting oil furnace processes are simple enough. The furnaces are preheated first for at least three hours at high temperatures to assure quick melting. The material then is charged, the material richest in zinc being introduced last after a sufficiently deep bath of fused metal has been formed. After melting down the charge the bath is puddled thoroughly, ashes and slag removed, and most of the sulphur extracted by washing two or three times with the soda-charcoal mixture. The alloy is then tapped, unless it is preferred to remove the absorbed gases by the freezing method.

Metal Exposed to Gases

While this oil-fired, tilting smelting furnace gives excellent results, it possesses the serious disadvantage, together with the reverberatory and a few types of crucible furnaces, of exposing the metal surface to the direct action of the heat and the contact of the hot gases. Besides, there is the inevitable corrosion of the lining at the metal surface, the hottest part of the furnace, where the soda-carbon mixtures or the other slag mixtures used hollow out the lining of the furnace within a comparatively short time.

Many of these disadvantages are avoided by melting and remelting the brasses in electric furnaces of correct construction. The first used types of electric melting furnaces, the indirect radiation furnaces, hardly are used at present, since on account of the high temperatures produced it is impossible to achieve high melting efficiencies, the loss of heat by radiation being excessive. The electric arc furnace is employed by several large American and Continental works for the melting of brass alloys.

The chief advantages of the induction furnace follow:

Gases of combustion are non-existent.

Outside air may be excluded from the furnace and the oxidizing influence of the atmosphere above the surface of the metal greatly neutralized by adding liberal amounts of charcoal, thus decreasing oxidation of the alloying components to a minimum.

Temperature of electric furnaces, particularly that of the induction type of furnace, may be closely controlled.

Chemical and physical properties also are controlled in the same way at all times.

Loss of metal by volatilization and oxidation is low.

Wear of refractory materials is low. Fireclay bricks of good quality will, if sufficiently basic in nature, last at least 200 charges, while as much as 1000 charges have frequently been obtained.

There is no appreciable heat radiation from any part of the furnace walls, the hottest part of the furnace being in the metal bath itself.

Cost of labor is much decreased, skilled labor being unnecessary.

Transportation and storage of fuel and ashes is eliminated.

Minimum space requirements and no need of special foundations.

Zinc oxide fumes practically are eliminated and spelter shakes are not possible even with laborers absolutely unused to smelter work.

In view of the importance of this type of furnace for the brass industry a short description of the principles involved may be of interest. The nature of the induction furnace is illustrated in Figs. 4 and 5. Fig. 4 represents a furnace manufactured by the Ajax Electrothermic Corp., Trenton, N. J. and Fig. 5 shows a type of induction furnace used on the continent.

Current is Induced

If a periodically variable current passes through a circuit, (Fig. 4) it will produce a periodically changing magnetic field which, in the drawing, is indicated by the dotted lines of force. If, now, a second circuit is situated near enough, so that the area enclosed is penetrated by the lines of force, an electromotive force is induced. As long as the circuit remains open, there is but an electromotive force, but as soon as this is closed, a current, the so-called induced current, is produced.

To better concentrate the lines of force, some material possessing a high conductivity for the magnetic lines of force may be interposed between the two circuits. Such a material of high magnetic permeability is iron.

Of the different types of induction furnaces with normal frequency, but one construction has maintained itself for the melting of non-ferrous metals in large quantities. This is the induction furnace with vertical melting channel.

In Fig. 4,*a* is the primary coil, *b*, the iron core, and *c*, the secondary coil or the melting channel. If an alternating current of normal frequency passes through the primary coil *a*, a current in induced in the melting channel representing the secondary coil, developes sufficient heat to melt the metal. These furnaces are characteristic in that the metal in the melting channel represents but a comparatively small part of the total charge and that this channel is permanently filled with fused metal exposed to the hydrostatic pressure of the metal above. For this reason this secondary coil offers the same resistance throughout the entire process, the amount of current produced being absolutely stationary.

Metal is Mixed

One of the most important properties of these furnaces is that the metal is thoroughly mixed by electrodynamic force and without mechanical help, the force mainly responsible for this circulatioin of metal being the *pinch effect*. It would lead too far afield to describe the mechanism of this phenomenon. The effect is, that a compressing force is exerted at the center of the channel. The degree of this pressure depends upon the strength of current passing through the conductor, growing directly as the square of the strength of cur-

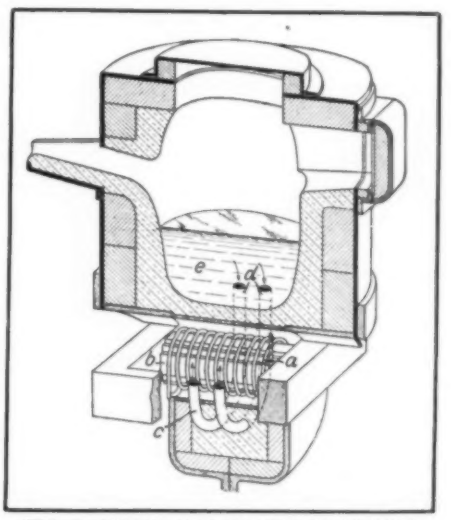


FIG. 5—METAL CIRCULATES THROUGH THE VERTICAL TUBES

rent. The melting channels are so proportioned that the degree of pressure produced exceeds the hydrostatic pressure of the superimposed column of metal.

As a consequence the metal is pressed out of the channel in accordance with the pulsations of the alternating current flowing through the secondary channel, fresh cold metal taking its place in the melting channel. The movement of metal thus produced is sufficiently lively to cause rapid and intimate mixing of the alloy with any metallic components, such as tin, lead, manganese, etc. added.

In closing attention should be called to one practical disadvantage of the induction furnace. Since the melting channel must be filled with liquid metal the furnace must be started with a molten charge. For the same reason it is more difficult than usual with other furnaces to change from one alloy to another. However, these disadvantages are of small practical importance only, since in all smelters there is always a furnace in which the small amount of molten charge may be prepared. If it is necessary to change another alloy it is simply necessary to dump the furnace to remove the old alloy from the melting channel and to give a small charge—just large enough to cover the channel—of the new alloy which will wash out the channel etc. and make the furnace ready for the fresh alloy.

Heat Is Within Bath

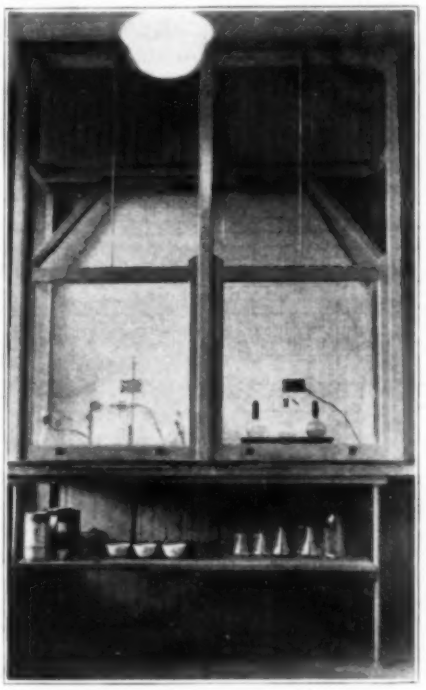
Another disadvantage is connected with one of the main advantages of the induction furnaces in calorific respects. Since the source of heat is situated within the metallic bath, this represents the hottest part of the furnace while the walls above the metal and the roof receive their heat by radiation from the metal only. Now if material of small cross section such as wire, thin metal sheet, etc. is charged, of which the surface of contact with the molten metal is but small in comparison to the volume, melting will be effected slowly, since the heat radiated from roof and walls in other types of melting furnaces is entirely missing here. However, since it is entirely permissible in the induction furnace to overheat the metal by a few hundred degrees Fahr. occasionally, a little more heat than usual may be applied whenever charges composed of large amounts of such light material must be put through.

These difficulties are avoided almost entirely by the latest modificatiion of induction furnaces, the high frequency furnace. In this furnace the metal may be brought to a melt without the use of a melting channel, so that solid metal may be charged and melted rapidly. In principle this furnace consists of a crucible surrounded by a watercooled primary coil and the external heat isolated, the contents of the crucible serving as secondary coil. In this type of induction furnace also the metal is mixed and stirred by electro-dynamic force.

Designs Fume Hood for Small Laboratory

By R. D. Billinger

An efficient type of fume hood used in a small routine laboratory is shown



HOOD IS WELL VENTILATED

in the accompanying illustration. It was designed by the writer for a foundry laboratory. The hood is 2½ x 5 feet in external dimensions, and the front, sides, and sloping top are made of glass. The floor and back of the hood are lined with white tile which is clean and acid proof.

Fumes are drawn out of the hood by means of a small suction fan located above the hood. Fan and motor are inclosed so as to be isolated from acid fumes. The two glass doors in the front are equipped with pulleys and weights and can be readily raised, lowered, or stopped in any desired position. Two small doors are more easily adjusted than one large door which sometimes sticks.

The hood is separated into two equal divisions by a glass partition. On the one side evaporations are conducted on an electric hot plate. The other side, which is equipped with a water suction filter pump and meker burners, is reserved for rapid filtrations and ignition of precipitates. Beneath the hood is a shelf for chemical glassware and reagents.

Why Does Casting Warp?

Question: We are forwarding for your inspection and opinion a 10 x 10-inch grating for the top of a gas stove. We make these gratings in various sizes. We have one pattern mounted singly on a matchplate, the others are mounted two on a plate but without exception and in spite of taking all precautions within our knowledge, the castings are warped when they are shaken out. We will appreciate your opinion on the probable cause of the trouble.

Answer: Castings become warped through many causes and nothing short of an actual examination of the pattern, the mold, the gates, and the method of pouring the castings and shaking them out would enable a person to put his finger definitely on the point of trouble. We have placed the casting on a perfectly flat surface and note that the ends are straight, the sides are bowed up in the center, the casting rocks from two corners and all the points in the center appear to be pulled down. So far as we know all these features with the exception of the rocking feature may truly represent the pattern. Then again the bowed sides and the pulled down center may be caused by warpage. If these points were definitely settled we could eliminate them from the list and concentrate on other probable causes of trouble. Assuming that the pattern is perfect, which of course in this case simply means that it is straight and flat and assuming further that the mold is supported properly on a level floor, we are driven to the conclusion that the design of the pattern is responsible for the warped condition of the casting. The interior ring is cut for expansion in two diagonally opposite corners. We suggest you cut similar gaps in the two remaining corners. The central gate is a disturbing element. Pour a few castings through four thin branch gates on one side and compare results.

Charles G. Olson, formerly in the main office of the Chain Belt Co., Milwaukee, has been transferred to the Detroit office at 8855 Woodward avenue.

How and Why in Brass Founding

By Charles Vickers

Finds Sand Too Fine

We are mailing you two sample castings from our foundry. We desire your opinion of these. Complete analysis of metal, conditions of melting, sand, and so forth, follow: Alloy used: 85 per cent copper; 4 per cent tin; 5 per cent lead; 6 per cent zinc; tensile strength, 29,000 pounds per square inch; elastic limit 20,000 pounds per square inch; elongation 16 per cent in 2 inches. Pouring temperature 2100 degrees Fahr. Sand moisture 6½ to 7½ per cent. Mold rammed about 30 pounds; 3-inch cope and 3-inch drag:

SAND ANALYSIS

Fineness	Mesh No.	Per cent
Remaining on	6	.00
Remaining on	12	.00
Remaining on	20	.02
Remaining on	40	.07
Remaining on	70	1.43
Remaining on	100	1.92
Remaining on	140	2.21
Remaining on	200	23.12
Remaining on	270	10.71
Through	270	39.86
Clay substance		20.66

Average grain size, 209.00

Moisture per cent	Permeability	Bond
4.0	6.0	131
7.0	7.4	148
9.0	8.6	151
10.8	7.3	153

Metal melted, one hour fifteen minutes; furnace opened, metal skimmed and bath covered with charcoal; added 1.25 pounds phosphor copper; added tin, lead and zinc—preheat 15 minutes, then pour into red hot crucibles on charcoal, 3 pounds of salt; 3 pounds borax. Amount of metal in the charge was 2000 pounds. It has always been our policy to keep our yellow brass and composition metals free of aluminum, although it is getting more and more difficult to do so.

Will you please advise what percentage of aluminum can be safely used in the above metals for pressure work, such as valves, ball cocks, brass unions and boiler couplings?

The two forwarded sample castings are bath cocks, turned off on the flanges and threaded on the coupling shanks, in which machine work reveals minute pores permeating the flanges, but limited to one-half of the flanges, mainly, and only observable along the threaded portion by aid of a magnifying glass.

The skin of the casting is entirely smooth and the color excellent. Evidently what is desired is to learn the cause of the porous areas. The answer is given us by the sand analysis, although it could be read just as well from the skin of the casting by the initiated. It is a case of sacrificing density to appearances in the machine or finishing shop, and it is quite possible there is some person in authority there who demands and insists on being given an extremely smooth-skinned brass casting, and such a person, if he exists, is an expensive luxury to have around.

A molding sand of which over 20 per cent passes a 270-mesh screen is entirely too fine for casting bath cocks. The percentage of moisture and the density of the ramming of the sand would be perfect, but the castings are bad just the same. All this wonderful analysis of molding and core sands means absolutely nothing unless we start off correctly in the first place, and to start off right it is necessary to have some person of experience, and this does not mean someone who has dodged the hard work of the foundry, and wore a white collar all his foundry days, but a real foundryman; one who knows as the result, not entirely of theory, but because of failures. No one on the face of this earth can learn the foundry business except by work. Men who love founding because it is a creative art, and have gone home covered with carbonaceous deposits on skin and clothing, and done it for years, can judge sands. The screens and all the other adjuncts are all right, but don't let us take them too seriously. At the start let us have someone, who knows by experience, tell us if we are right or not in our selection of molding sand for the work we are making. Then starting right, the young fellow with the sand tools will be able to keep us right, and we will make money.

This No. 00 Albany sand is not the correct grade for these bath cocks. The steam cannot escape, it enters the liquid metal as it sluggishly fills the upper part of the molds, and we have holes, fine holes no doubt, but they are there and they mean loss, because the castings have to be melted over again and the molding has to be done all over again, the buyer does not want such objects because there are other makers of exactly the same articles who understand molding sands and they produce sound castings. Such people use a No. 1 Albany and even a No. 1½ for polished castings, which is quite different to a No. 00 grade.

Writing as one of the few old fashioned molders now left in this country, the writer feels this question of molding sand is a serious matter. The really difficult thing is to get started right in the matter of correct grade; after that the laboratory control of the sand may work with efficiency, but with the wrong start the molding sand becomes a quicksand in which to sink the capital carrying the business, and any banker knows what that means. There are foundries with expensive control methods for sands, where they insist on the use of a silica sand finer than No. 00 Albany grade of molding sand, for making cores for bronze plungers and other castings weighing several hundred pounds, and the vents in such cores are mostly forgotten. It is a great mystery to them why those castings come spongy; to the old-timer it would be a mystery if they did not come spongy, they ought to anyway. Many fads in the foundry have come and gone. The sand control is a step in the right direction provided we do not start out on the wrong road.

In regard to these bath cocks, the molding sand has to be opened up by mixing coarser grades with the present grade. The metal is melted properly and handled properly, and it will give good castings when the steam is evacuated from the mold. The old molder with more leisure in making molds, would *needle vent* the flange in the cope, that is, stitch a thin vent wire through the top of the mold in the flange, but rapid production will not permit this. Another way of venting worth trying is to use an iron molder's gate cutter to scoop two channels down the cope parallel with the flask sides, and directly over the top of the flanges. These channels are cut after the mold is closed and before it is weighted. It will be surprising the gas that will come off from these channels. They might prevent the porosity.

We do not understand the salt addition to the ladles or carrying off crucibles. Salt is no good added in the ladle. It will make a horrible fume

(*Concluded on Page* 697)

Bill Discusses Worms *and* Brass Castings

By Pat Dwyer

ONE of my young lads now is at an age when puzzles appeal to his imagination. Oral puzzles, written puzzles, mechanical puzzles of paper, wood and metal claim a considerable part of his time, when he is home. From what I gather in a general way, they also furnish a considerable topic for conversation and argument when his gang ranges far afield or when they foregather in a fearful and wonderful shack attached like an overgrown swallow's nest to the garage in the back yard.

His mother declares this cozy retreat is a positive eyesore. She has implored me on numerous occasions to pull it down and when I point out that such a course would not be ethical since I have no card in the house wrecker's union, she basely claims I am too lazy and threatens to do it herself the first hour she has to spare.

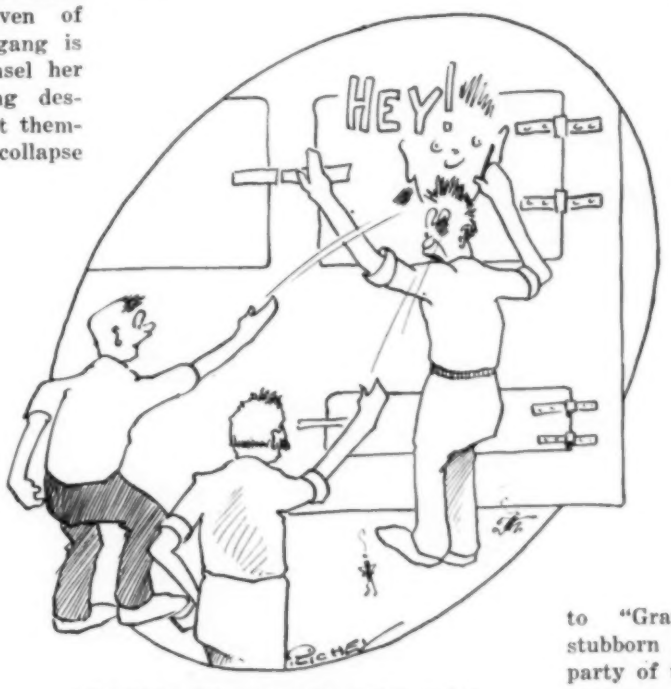
Basing my opinion on the noise which issues from this haven of refuge sometimes, when the gang is inside and going good, I counsel her to have patience. The young desperadoes probably will wreck it themselves. Some day it will collapse about their ears. Animated wrestling matches and miscellaneous boxing tournaments would shake a reinforced concrete vault to pieces. My own private opinion is that some day it will burn down from fire of an incendiary origin. The dear little sisters of the gang have been warned and chased away on innumerable occasions. Feminine curiosity irresistibly has drawn them back to apply an inquisitive eye and ear to the numerous chinks in the walls. Threats and counter threats have been exchanged freely. On one occasion the dear little cherubs actually set fire to a pile of newspapers at one corner of the pirate's stronghold and only the most prompt and energetic action on the part of the inmates who came tumbling out like a swarm of angry wasps, saved the edifice from destruction.

Sometimes at night and as a court of last resort I am asked to furnish a solution for one of the puzzles. You know, Paw knows everything! Usually, the puzzles are of a comparatively simple character. That is simple to the extent that they have engaged the attention of boys since time immemorial. Strange though it may seem to the rising young generation, I was a boy once upon a time and wasted my share of the precious hours trying to solve useless puzzles when I should have been engaged improving my mind and preparing myself to occupy an important niche in the hall of fame.

The niche still is empty and probably will remain unoccupied until I find some way of turning this early knowledge to account. For the present it serves a somewhat precarious purpose in helping me to retain a limited prestige as head of the family. The boy's mother claims he is wasting his time in this useless occupation. Also, and in no uncertain terms, she intimates I might find a more profitable way of spending my time than in acting as an accessory before, during and after these seances. Her idea of a method for spending the time profitably is to spend it in some form of violent exercise like digging in a garden.

Most of the puzzles, as I say, also their solutions are easy, since I have been over the road before, but I experienced considerable difficulty in explaining to his satisfaction the classic "Sisters and brothers I have none but that man's father (pointing to a photograph) is my father's son."

However, I did not consider that any reflection on his mentality. I worked in a shop down East in my early days where the same subject, brought up around the stove at noon, was debated by almost the entire crew for the remainder of the day. Some of the more enthusiastic members, carried away by the peculiar zeal which prompts us to force our views on others, almost came to blows. One word led to another after the fashion of words in a free and easy argument. Compliments were exchanged touching on the mentality, personal appearance and history, not only of the parties involved, but of their immediate and distant relations, past, present and to come. At the close of the day the answers to the problems ranged all the way from "Grandfather" to "Grandson." One particularly stubborn individual insisted that the party of the first part in the question was second cousin to the party of the



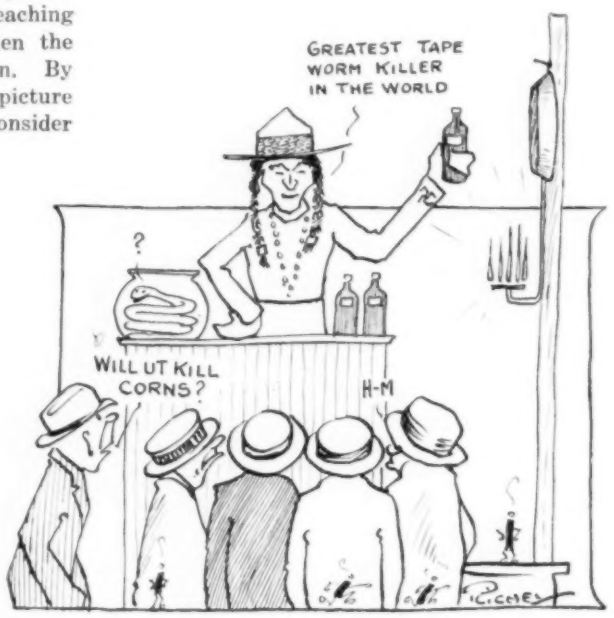
THE FACE ON THE CORE OVEN DOOR

second part a kind of mixed party.

In the shop we were somewhat handicapped by the fact that we had no photograph on which to base a demonstration. One resourceful lad attempted to get around this difficulty by sketching a figure of the mythical personage on the oven door and labeling it exhibit *A*. His well meant effort was not appreciated.

A barrage of old tobacco quids landed on the figure the instant the artist stepped to one side. With a wad over one eye and a handful of fine cut hanging from the chin the effect was ludicrous. Baltimore Nicholson with a happy gift in the use of the good old mother tongue said the thing looked more like a combination of the wrath of God, the wreck of the Hesperus and a wart hog, than it did like a human being.

Fortunately one of the boy's photographs was within easy reaching distance one night recently when the problem came up for discussion. By directing his attention to the picture and requesting him kindly to consider himself and myself as the two actors in the scene I finally succeeded in straightening out the tangle in the young man's mind. Filled with this wonderful piece of knowledge, the boy sought his mother to share it with her. She was only faintly interested. "I think the whole thing is kind of silly" she said. "The man who invented it must have been fond of hearing himself talk—like some other people—I am not mentioning any names, but I hope they are listening. Instead of going through that long rigmarole why did he not point to the picture and say 'That is a picture of my son?'"



HE COULD MAKE YOU BELIEVE YOU HAD 'EM

Well, as you might say in hearty man to man fashion, that was that. The glow of honest pride I had experienced in parading my superior knowledge died a quick and ignominious death. I reflected sadly that a prophet is not without honor and so forth. In future, says I to myself, this brave young hero can work out his own puzzles. I'm through.

The following night I discovered that actually I was through. He asked a question which I have heard debated many time, but to which I don't know yet whether the answer is yes or no.

"Now Paw" he said "Listen right close to this one. It's tough. I don't believe even you know the answer. We have been arguing over it all the afternoon.

"A 6-inch worm lived in a hole in the ground. You know a worm has a head at each end. This burrow had an opening at each end like a front door and a back door. One day the worm poked its head out through the front door and a robin grabbed it. The robin pulled and the worm pulled and at last the worm broke off in the middle and the robin hopped off with 3 inches of the worm in his bill. After a while a new 3 inches grew on the worm and it was the same length as before.

"Then one day the worm pushed its other head out through the back door and the same robin or perhaps one of his relations, grabbed it and pulled again. The worm broke off in the center and the robin walked off with 3 inches. In the course of time 3 inches grew on the worm again and he was the same length as before the accident.

"Now the question is, was this rebuilt worm the same worm who lived in the hole in the first place?"

"Well," I hedged rather cautiously, "That's rather a delicate question and I would not care to venture an opinion without further evidence. So far I only have your unsupported statement based on hearsay. Several points merit further consideration. Before I pronounce judgment I will have to see the worm and the robin. I am open to conviction, but I will have to see an actual demonstration before I believe a worm will survive bisection and grow a new 3-inch section with either a head or a tail on the end of it. Until this point is cleared up to the satisfaction of the court I refuse to commit myself to a definite dogmatic opinion either one way or the other.

"On a purely hypothetical basis you might claim that as the hole was occupied continuously by only one worm, in whole or in part, then it must have been the same worm all the time. The fact that he was shorter than usual on two different occasions is not material to the point at issue. The average man invariably is short before pay day, but still he is the same man.

"On the other hand as a famous authority points out—one *Q. E. D.*, Euclid—a tall dark gentleman who will cross your path in a few years and whom I know instinctively you will dislike exceedingly—the whole is no greater than its parts. If the parts are taken away, nothing remains. Therefore, *Q.E.F.*, if the parts disappeared voluntarily or by force, the original worm has vanished, and the worm remaining in the hole clearly is an impostor. The foregoing chain of reasoning is based on the assumption that the worm merely is a worm and is not endowed with an immortal soul. If we accept the claim, current in some quarters that every animate object is possessed of a spirit that never dies, but merely passes from one living form to another, then most assuredly that puts a different complexion on the problem. So long as the same old indomitable spirit permeated either 3 inches or 6 inches the worm did not change its identity. He was the same jolly little fellow he was at the beginning. Another angle—"

"Come away from that man" the boy's mother interrupted. "You have heard enough nonsense for one night. Another angle, indeed! First you drag Euclid into an argument about a silly worm and now I suppose you intend to prove that angle worms carry the spirits of the crusaders because they are always rambling here and there. Why don't you take advantage of the incident to teach the boy a useful lesson? Tell him that if the worm had minded its own business and stayed in the hole instead of sticking its head out to gawk around, it would not have been nipped by the robin."

"My dear," I said, "you simply anticipated me. The very thought

I had in mind. I was going to point out that the plaintiff in the case showed a culpable, if not criminal, carelessness in thus exposing himself to the hazards of traffic. If this point can be substantiated by the defense, then clearly—see U. S. supreme court, vol. 116, cap. 73—the plaintiff is all wet! Case dismissed."

This deliberate adoption of the lady's favorite stratagem, leading off on a new tack, brought her up into the wind for a moment. Before she could trim her head sails, throw the wheel over and crowd me once more toward the hungry rocks on a lee shore, Bill came rambling in through the door. The opportunity was lost.

"I don't mind talking to you now and again," she confided to me one time. "You show a gleam of almost human intelligence occasionally—but that Bill! He wants to do all the talking himself and all he talks about is the foundry." On this particular occasion she faded gracefully out of the picture and left me alone with Bill. I asked him what he knew about worms. "Worms?" said Bill, "What kind of worms? Your question reminds me of the story of the lady who asked the drug clerk for powder and he came back right snappily 'yes madam, face, gun or bug?' I might ask you in the same manner: Pin, tape or angle? How do I know whether you are talking about one of these or about book worms, hook worms, the worm of remorse, the diet of Wurms, glow worms, the worm in the apple, the worm who turned or the poor down trodden worm crushed under the iron heel of oppression.

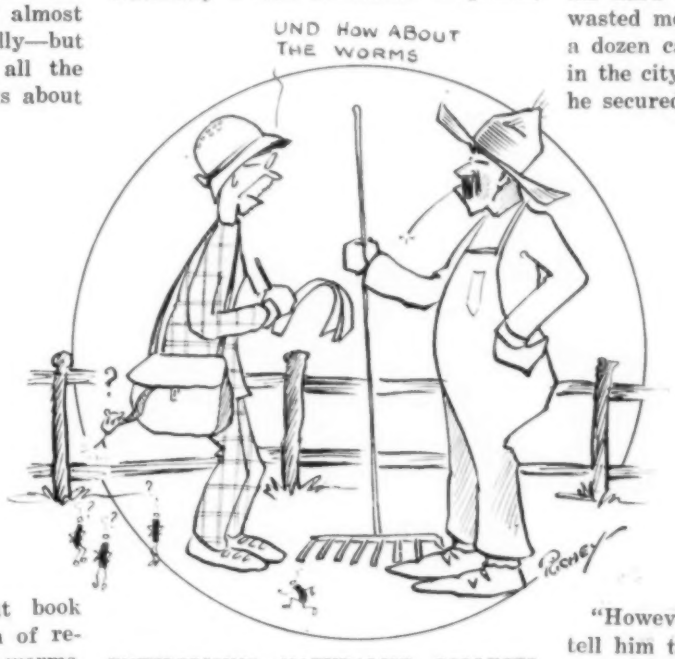
"To be perfectly frank my lad, my knowledge of worms is limited to what I learned many years ago while attending a clinic of the Kickapoo Indian Medicine Men on the village green. These gentlemen had a row of pickle bottles filled with 'deestructive par-a-sites ladees and gent-el-men that prey on the human race and every year claim a greater toll than war, famine and pes-ti-lence combined.

"However, in their capacity of benefactors to suffering humanity these philanthropists, for a limited time only, were prepared to offer a Sovereign Remedy, compounded from gums, barks, roots, herbs, berries and balsams from the famous Wah-wah tree of the Rocky mountains that would knock the everlasting tar out of these parasites and exterminate them if necessary from a graven image."

I told Bill I was not interested in Kickapoo Indian worms or in any other of the 57 varieties which probably he had in mind. I outlined to him as briefly as possible the problem of the worm who lived in the hole and who had been subjected to two severe tensile tests.

"Now," I said, "How many worms were involved in the deal, one or two?"

"Well," said Bill, "I'll tell you. We had an old crabby customer one time who brought up a somewhat similar question over a brass casting. Before he paid for the casting, he asked me if it was a new casting. Naturally I was somewhat surprised,



ENTERPRISING NATURALIST COLLECTS SOME STARTLING WORM STATISTICS

I thought he was dotty, but I assured him certainly it was a new casting, molded and poured a few hours before.

"He admitted that might be so, but what he wanted to know was whether it had been made from virgin metal or from scrap. I said I could not see what difference that made. As a matter of fact the casting had been poured from a mixture of ingot metal and scrap, but since it met all his specifications, physical and chemical he should be satisfied.

"Would you believe it? That old tightwad claimed I was trying to cheat him. He said that when he bought a new casting he wanted a new casting, not an old second hand substitute. I wasted more time than would pay for the casting trying to convince him, but could not make a dent in his ivory dome. He insisted he should have the casting for a second-hand price. Finally, in exasperation I told him that I only was charging him a second hand price based on the fact that I had used secondary metal. I was actuated by the best and most honest motive in making the casting. If he insisted I could make a casting from virgin metal, but the cost would be higher and the costing would serve his purpose no whit better than the one already in existence. At last I offered to give him the casting for nothing if he could get it duplicated at the price in the city from virgin metal. He was a tough old bird, the original skeptic from Missouri, and what advantage did he gain from his hard boiled attitude? None. He wasted more time than would pay for a dozen castings touring all the shops in the city getting quotations. Finally he secured a casting exactly like mine and made from the same identical mixture. When he asked the wily foundryman if it had been made from virgin metal, he was assured it was made from nothing else but. To convince the customer of the truth of the statement the lad took him into his office and showed him two copper pigs and a half slab of zinc. 'There's the stuff right there,' he said, 'virgin metal right from the refinery.'

"However, he prudently neglected to tell him these exhibition pieces represented his entire stock of new metal. Furthermore they were veterans bequeathed by his father and he would no more think of melting them than he would think of dropping his own good right eye in the crucible.

"Later he told me of the incident. 'Life is too short' he said, 'to waste time trying to explain technicalities to a layman. He may be a specialist in his own line, but I am a specialist in mine. If I gave him a casting that will serve his purpose satisfactorily and at a reasonable price, he should be satisfied. I know how to make castings and he does not. He has no more right to tell me how to prepare the metal than he has to tell me how to make the pattern, the mold or the style of furnace or fuel to be employed. If he was sick he would not ask the doctor what kind of medicine he was going to prescribe and certainly he would not ask the druggist where he got the googum or

(*Concluded on Page* 692)

STUDY FOUNDRY PROBLEMS

Ohio State Foundrymen's Association Holds Seventh Annual Convention at Cedar Point

KEEN interest in the problems facing the foundry industry developed at the seventh annual convention of the Ohio State Foundrymen's association, held at Cedar Point, O., Friday and Saturday, Aug. 19-20. Papers were presented covering several phases of foundry practice and management which constantly are requiring the attention of the manufacturer of castings. An unusually large number of foundrymen attending the meeting took part in the discussions which followed the presentation of the papers. Approximately 200 were registered at the convention.

C. C. SMITH
Elected President of the Ohio State Foundrymen's Association

DON McDANIEL
Chosen Vice President of the Group of Ohio Foundrymen

EDGAR SANDS
Re-elected to the Office of Treasurer of the Association

At the first technical session held Friday afternoon, Aug. 19, Eugene W. Smith, general foundry superintendent, the Crane Co., Chicago, presented an interesting paper on "Sand Control from a Foundryman's Viewpoint." He stated that in his opinion, 50 per cent of the defective castings produced in the foundry are caused by defects in the sand. Discussing the steps necessary to correct this evil, he pointed out that the proper selection of the sand is the first requirement. A careful study is necessary before a sand may be secured which will fit the particular needs of the specialized work in the foundry.

The second step in eliminating castings losses is to provide a system of tests which will permit accurate daily control of the sand heap. He pointed out that with accurate test data properly interpreted, the foundryman having a standard sand and two control sands, one for bonding purposes and the other for venting, should be able to prevent every possible loss, assuming of course that his equipment and metal are up to standard conditions.

A number of seemingly unimportant factors relating to practices followed in connection with sand were discussed to show the serious effect upon the product. These include improper tempering, excessive use of seacoal and the formation of gravel-like particles in the sand. Mr. Smith closed his talk by discussing a series of charts showing that the vibrator test, which he developed, has given him the information necessary to reduce his average casting loss for a year to 2.5 per cent. Several interesting sand specimens also were shown.

"New Merchandising Methods for the Foundry Industry" was the subject of a discussion by Phil Frankel, secretary of the Gray Iron Founders association, Cleveland. Mr. Frankel believes that new forms of competition found today throughout the industry are tending to destroy much of the work done in the past by various groups producing castings. Factors which are affecting the industry include the present tendency of manufacturers to buy only for immediate needs, excessive capacity, changes in methods of transportation, competition from within and competition from other industries. He stated that foundrymen have not made a united effort to study present conditions in the market and in future market possibilities. To show what has been done by various other groups of manufacturers he cited the advertising and research campaigns which have been carried on by producers of cement, paint, and paper board.

Howard C. Dunn, department of commerce, bureau of foreign and domestic commerce, Washington, who has been on a trip securing information on the foundry industry, spoke of a survey that is being undertaken by the department to secure considerable valuable information on the foundry industry and asked all foundrymen to render assistance by filling out the questionnaire which soon will

be mailed to all gray iron plants.

James A. Murphy, Hamilton, O.; O. J. Blank, Peck, Stow & Wilcox Co., Cleveland; Walter L. Seelbach, Walworth Run Foundry Co., Cleveland; H. M. Lane, Detroit and B. D. Fuller, Whitehead Brothers Co., Cleveland, discussed various changes that have taken place in recent years and emphasize the fact that publicity is necessary to further the interest of the industry. Mr. Murphy spoke of the substitutions for castings which have been made by certain stove manufacturers. He believes that publicity will show the buying public the anticorrosive and lasting qualities of cast iron, which in many cases is more suitable for certain classes of work. Mr. Seelbach suggested that a lesson may be learned by studying the methods followed by the ice manufacturers in the past few years. That group not only has offset any inroads in their business made by the sale of a large number of iceless refrigerators, but also has increased greatly the tonnage of ice sold. He stated this has been brought about by publicity and consolidations. Mr. Fuller spoke of the number of substitutions for castings which have been made in the electrical industry.

Discuss Handling Charges

"The Cost of Handling Small Orders" was the subject of a paper prepared by W. J. Donnelly, Geo. H. Smith Steel Casting Co., Milwaukee and read by C. C. Smith, Toledo Steel Castings Co., Toledo. The author pointed out that it costs just as much to make out the office forms for the small order as for the large, that order patterns for small orders usually take up the bulk of space in the storage room, and while the handling cost of small orders often is greater than for the large order, the foundryman fails to include this expense in quoting on the work. Mr. Donnelly believes that a minimum handling or invoice charge per order should be established by each foundry and that present cost methods should be further refined to embrace every element of cost. Mr. Murphy stated that undoubtedly foundry conditions were bad, but that this condition is due to the foundryman himself. Too often he learns the price which is being secured by a neighboring foundryman on a certain casting, and, assuming that the other fellow is making a profit, he offers to do the work for just a little less.

The annual banquet of the association was held Friday evening. Stuart Wells Utley, Detroit Steel Castings Co., Detroit, and president of the American Foundrymen's association, delivered the address. Mr. Utley discussed the fundamental developments which have taken place in industry and which directly measure the progress which has been made by the human race. While those on the outside charge that industry today is materialistic, thinking only of profits, he believes that industry does not think enough about profits. Rather industry is thinking constantly of the things it is making, of more automobiles, more houses, more tonnage. He believes that one change which is coming during the next few years is that industrial leaders will have to think more of profits and more attention will have to be paid to the proper reimbursement of those who, as stockholders, have contributed their stored up labor in the form of capital.

Study Labor Problems

Problems of labor management were discussed by Willis Wissler, bureau of business research, Ohio State university, Columbus, O., at the second technical session held Saturady morning. Mr. Wissler discussed labor conditions as they existed in the past or the *Golden Age*, traced the changes that have taken place and pointed to the line which future developments likely will follow. With the aid of a number of charts, he showed the work that is being carried on by the bureau of business research to solve problems of labor management.

Arnold Lenz, assistant general manager in charge of foundries, the Saginaw Products division, General Motors Corp., Saginaw, Mich., discussed "Quality, Quantity and Economy in Castings." He first compared foundry practice as followed by European and American foundries. He pointed out that in America more products constantly are being made on a quantity production basis. However, he believes that there always will be a place in the field for the jobbing shop, due to the new developments which constantly are being made and to the large tonnage of castings which will continue to be produced in small lots.

Possibilities of cost reduction under quantity production methods were discussed. He stated that at his plant the cost of cylinder blocks has been reduced 58 per cent in the past four years by the adoption of quantity production methods and that more money is being made under the present practice. However, he stated that in many cases mechanical equipment is not installed primarily to reduce costs, but to permit the use of unskilled labor, since skilled labor in many cases is not available. He told of the work that has been done to place the malleable plant on a quantity production basis and stated that the malleable industry offers an excellent field for the application of quantity production methods, due to the large tonnage of certain types of castings produced. Difficulties in continuous melting and in securing a proper annealing cycle have been overcome. At present the annealing cycle in his plant has been reduced to 92 hours.

Mr. Lenz told of the methods he uses in checking costs on each new job. When a new job enters the foundry the estimating department determines a theoretical cost. The job then is placed in the shop and each month a comparison of the actual and the theoretical cost is made. Any discrepancies are carefully checked. The same methods are followed for both labor and material costs. He emphasized the necessity for reducing scrap losses and stated that a reduction of 1 per cent in the scrap loss at the gray iron plant of the Saginaw company resulted in a saving of $8,600 monthly. Mr. Lenz also suggested that associations might find it valuable to undertake some work toward the standardization of cupola practice.

A round table luncheon was held Saturday noon at which the following subjects were discussed: Foundry Costs, E. T. Runge, chairman; Labor Management, Willis Wissler, chairman; Foundry Sand, Eugene Smith, chairman; Merchandising Methods, Phil Frankel, chairman; Quality Castings, Arnold Lenz, chairman.

Elect Officers

The board of directors of the association consists of 15 members, five of whom are elected yearly. New directors are as follows: William Baker, Baker Brothers, Toledo; Don McDaniel, Hamilton Foundry & Machine Co., Hamilton, O.; A. A. Nolte, Nolte Brass Foundry Co., Springfield, O.; Edgar Sands, Superior Gas Engine Co., Springfield, O.; C. C. Smith, Toledo Steel Casting Co., Toledo.

Executive officers were elected as follows: C. C. Smith, Toledo Steel Casting Co., Toledo, president; Don McDaniel, Hamilton Foundry & Machine Co., Hamilton, vice president; Arthur J. Tuscany, Cleveland, secretary; Edgar Sands, Superior Gas Engine Co., Springfield, treasurer.

Following the annual banquet on Friday evening, an informal reception and dance was held in the dance pavilion on the lake front. Special entertainment was provided for the ladies during the convention.

Place Strainer in Steel Casting Runner

By Michael R. Burns

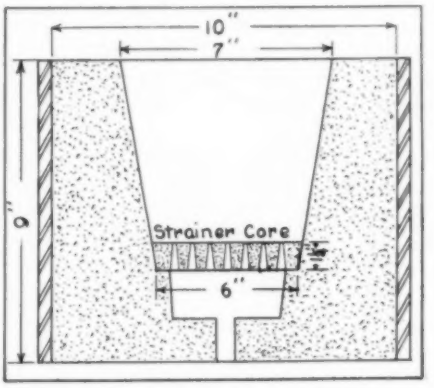
The accompanying illustration shows a type of runner cup with a strainer core in the bottom which has been used with gratifying success for the past three years in a prominent eastern steel foundry. Slag and dirt effectually are prevented from entering the mold. One of the principal advantages is that it requires no elaborate equipment. Also no exceptional skill is required on the part of the operator who makes the cups ready for the day's heat.

Sizes may vary to suit individual conditions. In the illustration the light steel runner box is 9 inches deep by 10 inches square. This leaves a minimum thickness of 1½ inches of sand between the side of the box and the 7-inch diameter runner basin. The only pattern equipment required is a tapered block in three steps and a plain circular corebox 6 inches diameter, 1¼ inches deep and provided with 39 tapered pins equally spaced. In the example shown the pins taper from ¼-inch to ⅜-inch. The outer edge of the core also is tapered so that it fits tightly in the bottom of the cup at the first shoulder. In practice the runner box is rammed on a jolt machine and dried. Then it is placed on the cope of a mold with the small hole in the bottom directly over the sprue in the cope. The strainer core then is dropped into place and the runner is ready. It is not necessary to anchor the core with nails or otherwise. Provided it is a reasonably tight fit it will remain in place during the pouring operation. In some instances where the runner is drained out clean it may be used a second time.

Close Iron Is Needed

Question: We shall appreciate your opinion on several points connected with the production of a small pump body which has to resist ammonia under a pressure of 250 pounds to the square inch. Can these castings be made from cupola melted metal. If so what blast pressure is best in a cupola lined to 28 inches. Is it customary to collect the iron in a forehearth to hold the carbon pickup to a minimum. What is the proper analysis for these castings with a thickness of metal section between 1 and 2 inches. What is the proper percentage of steel, cast iron scrap and pig iron to use in the mixture. Do the gating and feeding methods differ from those employed on ordinary gray iron castings or on castings containing 20 per cent steel.

Answer: On account of the exceedingly severe working conditions to which ammonia fittings are subjected they constitute a specialty in the foundry and tax the skill, ingenuity and knowledge of expert foundrymen. A multitude of detail is required in the production of any casting. In some instances one or more details may be slighted or even omitted altogether and still the casting may be acceptable. If the most insignificant detail is omitted in the sequence leading up to the production of an ammonia fitting, the casting will be scrapped. In the first place the pattern must be designed in such a manner that it will not cause leaky areas between heavy and light sections. This is one of the most prolific causes of



SECTIONAL VIEW OF RUNNER WITH STRAINER CORE IN PLACE

trouble and is blamed on nearly everything usually, before a decision finally is reached to change the pattern.

It goes without saying that the molds and cores must be made in a manner that will insure a quiet reception of the iron. The least commotion in the mold during the pouring period will be reflected in a porous area some place in the casting. Also, it is probably unnecessary to add that the casting must be gated in a manner that will prevent the entrance of any foreign material. Taking your questions in the order presented:

Undoubtedly the electric furnace or the air furnace are the most suitable types for melting metal since in either the analysis can be controlled closely and the carbon may be reduced. However, where neither of these furnaces is available, satisfactory metal may be melted in a cupola where the cupola man is an expert. In a 28-inch cupola the blast should not exceed 6 or 8 ounces pressure. Forehearths are not used to any extent in American foundries. Out of approximately 7000 stacks in use we doubt if 10 have forehearths attached. The device undoubtedly has merit and is employed extensively in European foundries. American foundrymen regard it as rather unnecessary and seem to prefer the plain cupola.

In establishing a suitable analysis you are confronted on one side with the necessity of getting a dense, hard metal. On the other side the metal must be machinable. Also you must take into account the factor involved in the use of a green sand or a dry sand mold. As stated previously every single feature involved in the production of the casting must be taken into consideration. For a casting with a 1-inch thickness of metal, an approximate analysis would be: Silicon, 1.00 per cent; sulphur, 0.10 per cent; phosphorus, 0.30 per cent; manganese, 0.70 per cent; total carbon, 3.50 per cent; graphitic carbon 0.50 per cent. This is for cupola melted metal. With an air furnace or an electric furnace the total carbon might be reduced to a considerable extent with a resulting increase in the density and strength of the iron.

In ordinary practice you will use approximately 25 per cent steel scrap, 25 per cent cast iron or malleable iron scrap mixed with 50 per cent pig. However, the relative proportions may be changed to a considerable extent without detriment. The actual mixture adopted depends to a great extent on the condition of the market and the supply of materials on hand. Many foundrymen insist on including from 10 to 20 per cent charcoal iron in mixtures of this kind.

Bill Discusses Worms and Brass Castings

(*Concluded from Page* 689)

how he prepared it."

"Very good, my dear little boy," I said, "But how about the worm? You have not yet answered that question."

"Ah! yes," said Bill, 'Just so, the worm. Le's see. Did you ever hear the story of the budding young ornithologist who learned with amazement that certain hard hearted people advocated the destruction of our little feathered friends, the English sparrows? He was quite convinced that sparrows fulfilled a useful purpose in destroying worms, bugs and other harmful parasites. Seeking first hand information on the subject he asked a farmer friend which was the worst form of pest, sparrows or worms?

"'Search me young fellow,' quoth the honest husbandman, 'I never had no sparrows!'"

Compares Cupola Refractories

Describes Results of an Extended Series of Experiments Designed to Show the Best Materials and Best Method of Application for the Lining Used in the Cupola

By G. S. Schaller

CUPOLA linings, for the most part, have received less consideration than any other important foundry raw material in the modern foundry scheme. The reason for this condition, apparently, is the willingness of foundrymen to accept any type of fire brick for the cupola because operating conditions and temperatures within the furnace are not fully known. Fairly accurate data are at hand regarding the operating temperatures, yet information of this type is not complete enough unless it is accompanied by the actual facts of operating conditions such as insulation, load, slags, etc.

According to specifications of a refractory material set forth by the A. S. T. M. the material must have a minimum cone fusion of Seger cone No. 19, which corresponds to a temperature of 2768 degrees Fahr. The bureau of standards in master specifications No. 335a, places the softening point at cone No. 31 approximately 3056 degrees Fahr. for fire clay brick, which is the accepted type of material for cupola linings. In defining the term *refractories* two distinct aspects must be kept in mind:

Resistance to the action of heat without regard to surrounding conditions and resistance to the action of heat in actual service.

Refractory materials are divided into three general classes, acid, basic and neutral, dependent upon their chemical composition and the type of reaction set up by their uses under service conditions. So far as the cupola is concerned, little or no attention need be paid these classifications, although their importance in steel making furnaces is common knowledge. The usual type of fire brick refractories used in the cupola contains a silica (SiO_2) content up to 65 per cent calculated on dry weight. The other important constituent being alumina (Al_2O_3), which shows a variable content but may be taken at about 25 per cent minimum.

A cupola lining is not seriously affected by load when the lining is installed in segments resting upon brackets spaced at not too great a distance. Theoretically, the only load sustained by any part of the lining is the dead weight of the short column of brick that extends to the next bracket—yet this becomes important at elevated temperatures, especially when the softening range of the brick is approached. The subject of failure under load has been studied by M. C. Booze and presented as technologic paper No. 2 of the American Refractories Institute.

ABSTRACTED practically in full from a paper presented before a convention of the American Foundrymen's association held in Chicago, June 6-10. The author G. S. Schaller has conducted a considerable amount of experimental work to determine just what characteristics are most essential and desirable in the clay daubing and brick lining of a cupola.

Mr. Schaller received his early foundry training at the plant of the Mendota Mfg. Co., Mendota, Ill. He was graduated from the University of Illinois, Urbana, Ill., in 1916 and from that time until he entered the army was employed by the Kawneer Mfg. Co., Niles, Mich. After the war he returned to the Mendota Mfg. Co. and later was employed by H. D. Crosby & Co. of the same city, until he was placed in charge of the engineering shops of the University of Washington, Seattle, Wash., in 1922.

Some of his conclusions are that the load test should not be used for determining the suitability of fire clay brick to meet a variety of service conditions. Deformation is not apt to be an important cause for failure of fire clay brick in a furnace wall and will occur only when a high temperature is developed at a considerable depth in the wall.

This conclusion will explain lining failures where a cupola is operated for long periods with a heavy lining—that is a cupola lined down for decreased melting capacity. Under such conditions the bricks become heated more uniformly than where they are laid as a single layer against the shell. The fluxing action within the brick takes place over a greater area than the exposed face, resulting in deformation of the brick.

Question of insulating the melting zone has been raised on several occasions. It can be seen from the foregoing statements that any attempt to prevent radiation through the lining will result disastrously. A much better method of heat conservation would be in the direction of utilizing the heat passing up the stack. Chances for success certainly would be greater due to higher radiation at this point than that which exists at the shell of the melting zone.

No doubt spalling is the greatest single cause for cupola lining failure. Usually it is caused by sudden changes in temperature, although the amount of destruction resulting is governed largely by the texture of the brick. This condition, therefore, goes back to the manufacture of brick. According to usual belief bricks made of finely ground clays are more apt to split on alternate heating and cooling than those made of coarse grained material. In the latter type, the strain is relieved by the fissures existing between the larger grains, which, as a rule, are not so continuous as in the finer grained material, thereby preventing a distinct cleavage line.

Spalling is greatest in the vicinity

of the tuyeres, due to the entrance of air at room temperatures impinging upon the hottest part of the lining. The directions of the air currents are continually changing because of the shifting of the particles of the charge as well as the metal and slag streams.

Application of daubing mixtures to cupola linings also has an effect upon spalling. In common practice the lining is wet thoroughly to cause the daubing to stick, yet it leads to distressing results unless properly handled. When the cupola is heated rapidly before the daubing has dried out completely, steam is generated between the lining and the daubing, which causes the latter material to become dislodged, with the result that the lining is left unprotected. The daubing laid open through broken patches is weakened and susceptible to abrasion, particularly at the upper part of the melting zone.

Daubing material often cracks and falls out, due to the loss of moisture in the original mixture. This condition can be prevented in a large degree by noting particularly the character of the fire clay forming the base of the daubing mixture. With fat clays it is well to use a large proportion of grog in the daubing mixture. Satisfactory grog is made by grinding worn out fire brick to about a 12 mesh size and mixing with only enough clay and water to give the desired bond.

Select the Clay

Care must be given to selection of materials used in the daubing mixture. The fire clay should be equal in quality to the brick and nothing but highly siliceous sand should be employed. The grog likewise should be ground only from fire brick of accepted quality. Dr. Moldenke in *The Principles of Iron Founding* pointedly refers to the folly of using local clays in daubing mixtures, yet the writer encountered one cupola in which building sand was employed in addition to this type of clay. The owner complained about excessive slags and short lived linings, both of which were to be expected under the circumstances.

The idea of using a solution of common salt as a wash over the daubing mixture has been suggested to form a glaze over the lining and thus increase the refractoriness as well as the resistance to abrasion. Practice of using salt for glazing ware is successful, but in a cupola lining a different set of conditions must be confronted. At the elevated temperatures encountered in the cupola lining the salt may volatilize and produce a vapor which when condensed will have a corrosive action on the refractory lining by increasing its tendency to fuse more easily.

Excellent opportunity exists to increase the utility of the daubing mixture by the addition of highly refractory materials, preferably of a neutral character. The writer used a heavy coating of carbonaceous material over the daubing mixture during a trial heat in the engineering shops cupola at the University of Washington. While the results of a single test are far from conclusive it would appear that improved lining conditions resulted. This experiment was tried mainly to combat fluxing or slag action.

Action of Slag

Reason for lining failures in the melting zone can be traced in large measure to the corrosive action of the slag. This readily is apparent when the acid nature of fire clay brick at elevated temperatures is considered, keeping in mind the basic nature of the lime slag. Theoretically, this reaction between an acid and a base should result in the formation of a salt. In a cupola the reaction is not so simple, with other fluxing agents present which add to the complexity of the entire situation.

According to an article by A. H. Kuechler in the *Journal* American Ceramic Society, vol. 9, No. 2, Feb., 1926, iron oxide is a potent flux which tends to lower the deformation period of fire clay refractories.

Complex and variable nature of cupola slags makes a detailed study of their corrosive action a difficult subject. Hirsch has found that cupola slags penetrate fire brick chiefly through mechanical action. Portland cement has a corrosive action tending to dissolve silica and alumina to form new compounds. Lime in fire clay reduces the fusion point of the resulting brick. According to Searle alkalies vaporize at operating temperatures and are detrimental to fire clay brick upon condensation of the vapor.

Corrosive effect of slags also is governed by the manner in which the lining originally is laid. Large or wide joints permit relatively easy penetration, a condition accelerated through the use of inferior clays for grouting. A good general rule to follow would be to use the same kind of fire clay for the mortar that is employed in the manufacture of the brick.

Nature of the brick or cupola blocks also must be considered. With coarse material slag penetration is more rapid than where a dense, compact surface is encountered. If the materials are of the fine texture and the slag particles also are finely divided, rapid corrosion is bound to result. A cupola brick to withstand slag corrosion should present a firm exterior. This can be obtained in the manufacture of the brick by pressure, that will force clay laden with water to the surface.

Importance of a proper surface readily shows up when the lining is picked out and the vitreous surface of the brick is injured. Under such circumstances careful daubing is the remedy. Production of a well vitrified surface is a function of the burning process. Some manufacturers burn the best grades of fire brick twice to produce the desired results. A. Reynolds has an English patent on a method of increasing resistance to corrosion by subjecting the working face of the ware after its first firing to a temperature sufficiently high to produce incipient fusion. The bricks are embedded in the floor of the furnace with their working surface exposed. The spaces between are filled with some highly refractory material.

Other sources of slag corrosion may affect the refractoriness of brick in the cupola. Sulphur may be changed to sulphuric acid (H_2SO_4) whenever moisture is encountered in the fuel. Ash content of the slag should not be overlooked. In summing up the reasons for slag action, lime and alkalies, two potent fluxing agencies, undoubtedly are the main accountable elements.

Subject to Abrasion

Cupola linings, unlike the linings in many types of metallurgical furnaces, are subjected to deterioration by the abrasive action of the descending charges from the charging door to the melting zone. The problem presented is not as acute as the one afforded at the melting zone, but the proper selection of lining material must be considered.

A close, hard, well burned surface on a brick, in fact, the same type of brick that offers the highest slag resistance, offers the highest resistance to abrasion.

Other elements tending to destroy cupola linings are the cutting action of flames, and the chemical reactions set up through operating both under reducing and oxidation conditions. While the former condition is to be expected, the latter often may be encountered.

Employment of monolithic linings in cupola furnaces appears to be gaining in popularity. Many attractive features are connected with this plan and its broader adoption is being delayed more or less through the old idea that a radical departure from standard practice must be subjected to a thorough probation period. Mono-

(*Concluded on Page* 699)

Why Do Pulley Arms Crack?

Uneven Cooling Speed Sets Up Contraction Strains That Cause Distortion—Remedies Suggested Where Due To Design, Melting or Molding Practice

By H. N. Tuttle

ANY foundry making a wide range of pulleys, of various sizes and designs, from time to time will encounter troubles in the way of cracked spokes, cracked rims, and warped, distorted and strained castings.

Causes of these troubles usually may be traced to faulty design, faulty molding or faulty metal, and often to a combination of two or more of these faults.

Direct cause of practically all pulley casting troubles is due to unequal cooling.

If the mold and casting could be placed in an oven immediately and allowed to cool so gradually that all parts would cool at exactly the same rate, then there would be no cooling strains and consequently no cracked or distorted castings.

The most common pulley casting trouble is the breaking of the spoke near the rim. The light rim on account of its thinner section and because it is nearer the outside of the mold, cools faster than the spokes and hub. The rim becomes black hot while the spokes and hub still are red. At this stage the rim has contracted correspondingly more than the spokes. As the spokes are still red hot and in a weak almost friable condition while the rim is black and much stronger, the contraction of the rim crushes in, or shortens the spokes an appreciable distance; say, 1/64 or 1/32-inch. Due to its semiplastic condition, this does not weaken or bend the spoke.

Crack the Spokes

Later, when the contraction of the rim has slowed up, while that of the cooling hub and spokes has increased, this 1/64 or 1/32-inch contraction which previously has taken place in the rim also must take place in the spokes. The result must be either a cracked spoke or a casting with an internal strain.

Foundrymen often remark that a cracked spoke in a pulley does no harm, that the strain has been removed and that the pulley is better than before, etc. While this may be more or less true, still the appearance is bad and is not liked by the customer. We never see any one intentionally cracking pulley spokes to make them better.

Several remedies are available for this trouble. The two most obvious are to thin the spoke, reduce the diameter of the hub, or both. If this is not permissible, or, if after it is done the trouble continues, a larger fillet where the spoke joins the rim, may cure it. The larger fillet has a tendency to throw the point of strain farther in toward the bottom part of the casting, which may stretch slightly. Also it spreads the strain over a slightly larger area.

However, a more certain way is to add a small thin brace that will tie the spoke to the rim. This brace should be made quite thin, so that it may cool off quickly, and thus be strong enough to resist the cracking strain at this point.

Figs. 1 and 2 show this brace, or bracket, and an easy way of attaching it to split iron patterns or to any metal pattern.

Cast in Wood Molds

The brace is shown at *A* Fig. 1 while *B* shows a longitudinal section through the brace. This brace is cast on the pattern in place. It is cast around the brads *C C*, which are a tight drive fit in the drilled holes previously made in the correct location in rim and spokes.

Two halves of the wood mold in which the brace is cast are shown at *D D*, Fig. 2. Common half and half solder is a convenient metal for casting in wood molds. It melts at a low temperature and will not scorch the wood. The wood mold made in two blocks as shown simplifies the carving. The joint also makes a perfect centerline for locating the mold correctly upon the pattern, as well as a convenience in removing the mold in case any over run which would lock a solid mold on to the pattern. *E* shows the pouring sprue. *F* is a wedge for clamping the mold to the pattern.

Sometimes the spokes instead of breaking will pull the rim in at the end of each spoke as in Fig. 3. The writer recently saw a casting of this kind in which the rim on a 36-inch diameter pulley was pulled in approximately 1/16-inch at each spoke. As this pulley was not finished on the outside, it presented a bad appearance when running. This pulley had a light hub and it was evident that the trouble was caused by the contraction of the long spokes after the rim had cooled.

In this instance it was not permissible to thin the spokes but an equal cooling rate was secured by chilling the spokes.

Equalize Cooling Speed

A long chill, *A* Fig. 3 and *B* Fig. 4 was placed on each spoke in the drag mold only and rammed in place. After the pattern mounted on a hand stripper was drawn, the chills were removed from the pattern and placed in their impressions in the drag mold.

This equalized the cooling so well that the castings were not out of round to exceed 1/64-inch at any point.

Another method of equalizing the cooling is to uncover the hub, leave the rim covered, and if necessary, remove the core, and even pour water on the hub and spokes. A little experimenting along this line generally is necessary.

A chill cast around the hub sometimes will cure this trouble. If this expedient is resorted to, care should be taken to make the chill extend beyond the hub about ⅛-inch as shown at *G* Fig. 5. If the chill is made flush with the end of the hub, a little iron may run over the end of the chill, make it hard to remove and sometimes ruin the chill.

Sometimes a small chill applied right over the cracking point will save the casting.

While the foregoing reasoning is based upon the effort to obtain uniform cooling, some foundrymen make the spokes heavier on the theory that if the spokes are increased enough to pull in the rim rather than crack the remedy is good enough. This may be true with small pulleys, but in larger ones it pro-

duces the trouble shown in Fig. 3, and in any case it adds to the cost of the pulley.

If it is known when making the master pattern that there is danger of a spoke crack near the rim, a thin fillet rib, as shown at *EE*, Fig. 1 may be put in the pattern. This rib looks better than the braces shown at *A* and *B*. It is hard to put in a split iron pattern, but easily is applied to the master pattern.

Cracked Rims

Spokes too light in proportion to the rim sometimes cause the rim to crack, but more often throw the pulley out of round. The casting will resemble that in Fig. 3, except that the rim will be high at the ends of the spokes instead of in between. The rim, cooling last and stretching across from spoke to spoke, makes the diameter less between the spokes.

If the rim cracks, the crack will open up, as shown at *I*, Fig. 6. When the rim is cracked and does not open, but on the contrary pinches tightly together and even shucks by, as shown at *H*, Fig. 6, this is due to the spokes being too heavy for the rim. If the force which cracked the pulley at *H* is great enough to let the parts pass by as shown, then the internal strain of a too heavy spoke or hub will draw the rim in, as shown, and relieve the strain in the same way as a broken spoke.

In case of doubt, it will be well to make an experimental casting to be altered by some simple molding expedient, before permanently altering the metal pattern.

A pulley flange or central web cast separate from the pulley caused a good deal of trouble by distortion. It is shown in Fig. 7, a thin plate about 16-inches diameter, 3/16-inch thick with a hub of about 11/16-inch metal. The castings came so badly warped or *fluttered*, to use a wood pattern-making term that it was impossible to use them.

A similar condition sometimes is found in circular saws, where the circumference is too great for the diameter and the excess metal causes the saw to run out sidewise. The sawyer takes the strain out of the

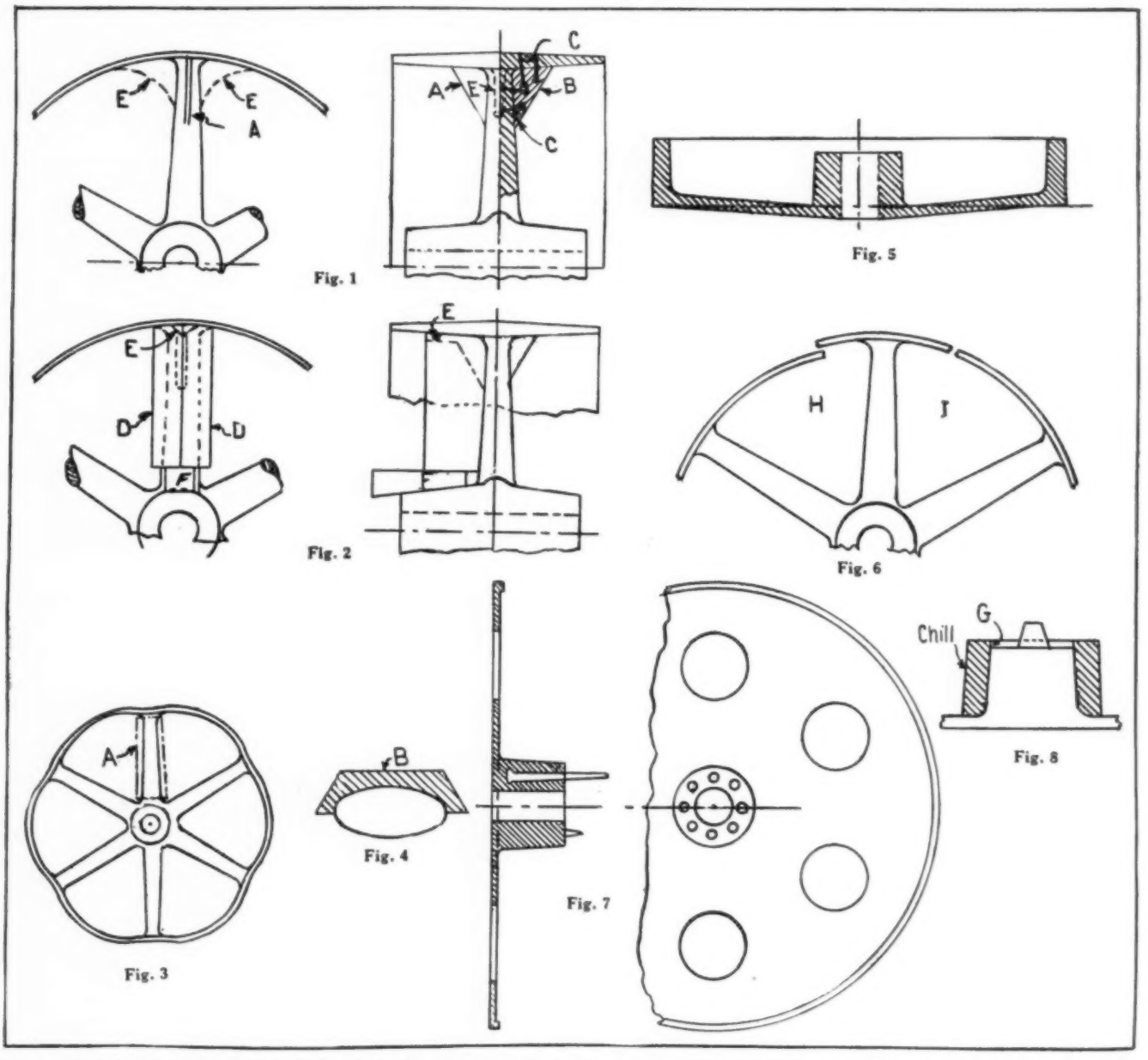


FIG. 1—ELEVATION AND SIDE VIEW ILLUSTRATING THE USE OF A BRACE. FIG. 2—SIMILAR VIEWS SHOWING APPLICATION OF WOOD MOLDS. FIG. 3—EXAGGERATED VIEW OF PULLEY IN WHICH ARMS DID NOT CRACK BUT PULLED RIM OUT OF SHAPE. FIG. 4—CHILL FOR COOLING ARM. FIG. 5—THIN ARMS AND HUB ON PATTERN CASTING BOWED IN CENTER. FIG. 6—LONG HEAVY ARMS CRACK THE RIM. FIG. 7—NAILS INSERTED IN HUB PREVENT DISTORTION. FIG. 8—SOMETIMES IT IS NECESSARY TO CHILL THE HUB

A LEXICON OF TECHNICAL TERMS

By O. W. Potter

(*Continued from Data Sheet No.* 680)

Static Strength

Resistance to loads slowly and gradually applied. Stresses may be classified according to the manner in which the forces are applied.

Static Stresses are those which result from gradual and steady application of a steady or constant load. Fatigue Stresses are those which result from repeated application of a load. Impact Stresses are those resulting from a sudden blow. Dynamic Stresses are repeated impact or vibratory stresses.

Dynamic Strength

Resistance to loads suddenly applied (shock) or to repeated stresses. (See Static Strength.)

Bending Strength

The angle through which a test specimen of a given size can be bent without rupture is a measure of the bending strength. This is sometimes called *transverse* or *flexural* strength. Transverse is the common term used for testing cast irons and structural members such as wood timbers, columns, beams, girders, etc. Bending strength is used more generally in connection with the more ductile alloys such as ordinary steels.

A soft steel (low carbon) bar ½ x 1 inch can be bent around a 1-inch diameter bar through an angle of 180 degrees without rupture.

Compressive or Crushing Strength

Maximum load in pounds per square inch required to break a material by pressure in one direction. Some relative figures follow:

Material	Pounds per square inch
Wrought iron	Average 50,000*
Carbon steels	Average 60,000*
Malleable cast iron	Average 90,000
White cast iron	60,000-200,000
Gray cast iron	60,000-200,000

*Yield point is taken as ultimate in the more ductile materials.

Fatigue Resistance

Resistance to failure by repeated stresses below the elastic limit. It may be considered the number of times a load below the elastic limit must be applied to produce failure.

Many thousands to millions of repeated stresses are required to rupture the alloys of the iron carbon series, depending on the chemical composition, heat treatment, method of stressing, temperature during stress, etc.

Fatigue Strength

The maximum stress in tension which will not cause rupture corresponding to any given range is called fatigue strength. That is, the greatest load which will not rupture the specimen when subjected to 6,000,000 repetitions of the stress in a given time and at a given rate of loading. This stress is then the fatigue strength of this cycle.

(*Continued on Data Sheet No.* 684)

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 683)

Notch Toughness

Resistance to rupture by impact (sudden shock) on a notched specimen. The shape and size of the notch materially affect the results. For this reason testing is often done without notching and it is then called *impact shear test*. The Charpy is the common machine used and the values given are for unnotched bars.

0.37 carbon steel	15.8 foot pounds (Charpy)
High carbon steel	1.9 foot pounds (Charpy)
Alloy steel (heat treated)	20-45 foot pounds (Charpy)
Malleable iron	8 foot pounds (Charpy)

(Standard test bar, 10 millimeters square with 45 degree notch. Tested on machine with 53.3 meter-kilogram pendulum).

Shear Strength (*Flexural Rigidity*)

The maximum load in pounds per square inch required to break a material by two forces acting in opposite directions along the same plane. Examples follow:

Material	Pounds per square inch
Wrought iron	Average 40,000
Ordinary carbon steel	Average 50,000
Gray cast iron	Average 18,000
Malleable iron	Average 42,000

Tensile Strength (*Pulling Strength*)

The maximum load in pounds per square inch required to break a material by a pulling stress.

Material	Pounds per square inch
Wrought iron	50,000
Mild steel	50,000-65,000
High carbon steel	50,000-100,000
Alloy steels	50,000-400,000
Malleable cast iron	40,000-55,000
White cast iron	30,000-40,000
Gray cast iron	15,000-30,000
Semi-steel	25,000-40,000

Tensile strength is the most common strength property. It is easily determined and is usually used in conjunction with other strength properties. The tensile strength is influenced by a great many things, such as direction of loading, rate of loading, temperature, heat treatment of specimen, etc.

Torsional Strength

The maximum load (acting as a moment) required to twist a material to failure. Failure always occurs through shear stresses set up and the numerical values are the same as for shear strength of the material. (See Shear Strength.)

(*Continued on Data Sheet No.* 685)

THE FOUNDRY DATA SHEET, SEPT. 1, 1927

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

center of the center of the saw by hammering. A similar line of reasoning was used in molding the flange casting.

A row of cast iron nails was inserted in the hub as shown, whereupon the castings came out perfectly true. Eight small prints were placed on the pattern to show the molder where to set the nails.

Distortion of this casting came rather later than we had supposed. In experimenting, several castings were shaken out hot and stood edgewise, vertically in the sand heap to cool. They remained straight until cooled to almost deadblack and we thought we had found a remedy. Much to our surprise and disappointment we found them warped as much as usual when cold.

Castings Heat Treated

In making a cast iron half pulley for a pattern, where the rim had to be extra heavy on account of double finish, the half spokes long and light with a file finish only, the castings were warped to such an extent that the spokes in the center were bowed up on the parting side more than the thickness of the half spoke as shown in Fig. 8.

Several of these castings were placed in an oven, heated red, taken out and clamped to a surface plate and then returned to the oven. They were allowed 24 hours to cool and then taken out. When the clamps were removed the castings were found to be perfectly flat. They were finished for patterns and never have shown any disposition to warp since.

Sometimes a pulley from a certain pattern will crack when it never has done so before. In this case it is well to look to the metal mixture.

Changing the molding methods also may make trouble. The gating sometimes affects the strain. Where the rim is too light, a runner sometimes is carried all around the pulley and several gates cut in, as in gating hollow ware. This holds the heat in the rim, but is expensive as it takes a larger flask and makes more waste iron.

If a casting is found to be cracked, strained or warped, it is well to study the problem in the light of unequal cooling. If the design can be changed, this is the easiest way to handle the case. If this is not possible, then various molding methods, application of chills, cooling fins, uncovering, watering, r e g a t i n g, strengthening ribs, using internal chills, coring out heavy metal, etc., should be considered and the most feasible tried out, experimentally, until relief is obtained.

In extreme cases it may be better to change from spokes to a web. A web, reasonably well designed, seldom causes trouble, unless the holes are too large, or too close together.

In fact a web pulley has an advantage when mounting on a stripper. The whole web acts as a stool plate and can be finished in a lathe thus eliminating the expensive hand work of filing the spokes and fitting the stool plates between them.

Oval spokes in extreme cases may be changed to *T* or *H* section to make them cool faster without reducing their strength.

If the spokes are too light they easily are made heavier, but it is always well for economy to try the lightening methods first. The question is one of ratio, or relation of one part to another. Making one part lighter is the same as making another part heavier, when it comes to even or uneven cooling.

Finds Sand Too Fine

(Concluded from Page 686)

for the men to breathe and on that account should never be permitted. To be of any value at all, salt has to be used in the furnace. It is decomposed by the heat and its products protect the metal from oxidation, before it is melted.

The borax, while it does no harm, does no good either. There is no need at all for any covering on the carrying off crucibles, but if one feels the pouring off gang will work better with the metal surface covered, what is the matter with a little granulated charcoal? That has to kept out of the open mouths of the sprues, though, personally, give me no covering on ladles, except on copper. The alloy you use does not need it.

As to aluminum in metal for pressure work, the safe limit is absolutely none, and that is the only safe limit. It is a mighty good policy to keep it away from pressure alloys. It is not only unnecessary, but harmful even when it does not cause loss through leakers. Aluminum in small amount in red brass of the composition herewith given, changes the crystallization and promotes leakage. Also if castings happen to be broken off the gates while hot, the crystals will be likely to tear like molasses candy, and the tear takes a piece out of the casting.

We suggest opening up the sand piles for these and all polished castings; channel venting the copes; a gradual substitution of aluminum bottom plates in place of boards, the aluminum plates to be slotted with staggered rows of longitudinal holes to vent the molding sand; the elimination of salt and borax on the ladles as unnecessary nuisances. The cores do not need venting if they are made on core machines and silica sand is used bonded with core oil.

Will Present Papers

The International Congress for Testing Materials which will be held at Amsterdam, Holland, from Sept. 12 to 17 promises to have interest for the experts from many nations. Papers will be presented at the general meetings by T. D. Lynch, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. on "Materials Testing as a Stimulus to Research," A. Mesnager, Paris, France, on "The Fracture of Solids"; Prof. Korber, Dusseldorf, Germany, on "The Problem of Elongation Limits," and Dr. Rosenhain, England, on "Plastic Deformation and Fracture of Metals".

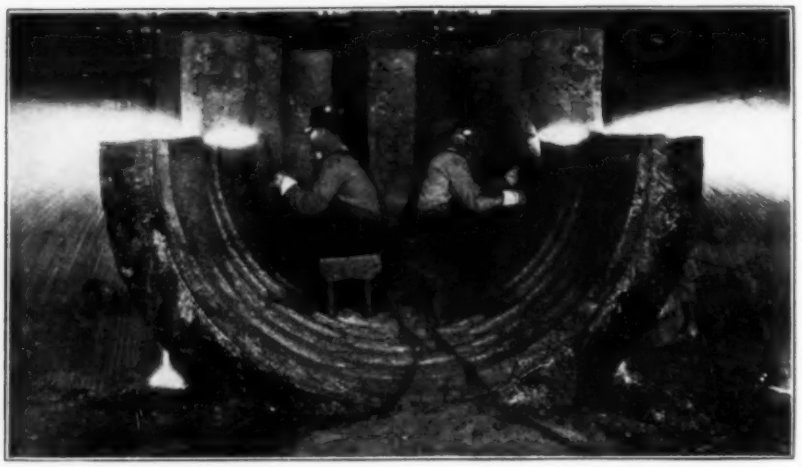
Subjects to be treated at the congress will be divided into three sections, on metals; cement, concrete, stone and bricks; miscellaneous. Twenty-seven papers will be presented in each section and will be read in English, French or German. Meetings of the congress will be held at the University of Amsterdam. During the meeting a boat trip to the Ymuiden harbor will be arranged and a banquet at Scheveningen near the Hague will close the congress. During the sessions trips to Ryksmuseum, Volendam, and Marken will be arranged for the ladies. An exhibit of materials from the Dutch colonies will be held at the Royal Colonial institute, Amsterdam, during the congress.

Number of Men Needed

Question: We run an average heat of 11 tons on stove plate and furnace castings and we shall appreciate an expression of opinion on the number of men required to assist the cupola tender.

Answer: For a 11-ton heat you probably are running a 40 or 42-inch cupola that will run the heat off inside of 2 hours. Under ordinary conditions three men will be required, the melter and two helpers. The melter and one helper prepare the cupola, put up the doors, make the bottom, place the coke bed and light it. The second helper puts up the iron and coke. After the wind goes on both helpers charge the cupola and the melter stays down in front and taps the metal.

Steel Foundry Cuts Risers with City Gas



By Herbert R. Simonds

Fig. 1—Cutting Risers from Steel Castings

AT THE Atlantic City convention of the American Gas association a year ago, announcement was made that the General Electric Co., Schenectady, N. Y., had developed a successful method of cutting steel with city gas. That company now is using gas in at least two of its foundries, one at Schenectady and one at Everett, Mass.

The change from hydrogen to city gas has necessitated a great amount of experimental work and much of the experimenting has centered in the torch. A paper by F. P. Wilson Jr., the General Electric Co., which was published in the *General Electric Review*, June 1926, describes the theory involved in the use of illuminating gas. Mr. Wilson is given credit for developing the torch which makes city gas a practical agent in steel cutting.

The function of any metal cutting blow pipe is two fold. First the steel is heated at the point where the cut is to be started, and then a jet of pure oxygen is released which cuts the steel. The first torches which were designed to use city gas, contained superheating coils within the torch itself. These coils used an auxiliary city gas burner. The torches, while developing remarkable efficiency in cutting, had many disadvantages. They were heavy and became so hot that the operator often was handicapped in manipulating them in confined spaces. In the present practice at the Everett steel foundry these torches have been replaced entirely. A standard form of torch is used with specially designed tip.

Describes Present Practice

Following the work of F. P. Wilson Jr., at Schenectady, William Irby, of the Lynn works of the General Electric Co., carried on an intensive study of the use of city gas in the steel foundry at Everett. Conditions in this foundry call for the cutting off of risers up to 22 inches in diameter. The chief features in Mr. Irby's investigation were the design of tip, the pressure of city gas, the pressure of oxygen, and in certain cases the enrichening of the gas with other ingredients, principally benzol.

The theory and detailed results of this work are beyond the scope of this article. However, it is thought that some of the details of present practice may be of assistance to such foundries as may be considering the use of city gas. Gas is received at the Everett steel foundry from the regular city mains at about a 5-inch pressure. Gas is produced by the Malden & Melrose Gas Co. and averages 4.9 per cent nitrogen or less. It is of a good average quality and costs $1.25 a thousand cubic feet.

The gas main enters a small building immediately outside of the foundry where the pressure is built up to 60 pounds by an automatic pressure pump. From here it passes through flash backs or water seals into a 6-inch main which extends underground for 120 feet along the side of the foundry. This main acts as a reservoir, and from it two 1-inch pipe leads run direct to two cutting stations within the foundry. One of these stations has three cutters and the other two cutters.

Oxygen is received in high pressure cylinders. A separate building at some distance from the gas pump building serves as the oxygen supply source. Here the high pressure oxygen in the cylinders is passed through reducing valves, then through flash backs to 1-inch pipe mains which go direct to the two cutting stations in the foundry. The torches have valves for further regulating the pressure.

In general the pressures actually used for cutting sections 10 x 10 inches or greater are 150 pounds for the oxygen and 30 pounds for the gas. For smaller sections the oxygen pressure is reduced to about 60 pounds and the gas pressure to about 5 pounds. These

Cutting Data Using City Gas

Area of cut, inches	Pressure in pounds Oxygen	Gas	Area of Test	Time required for Preheating	Cutting minutes
11 by 20	150	30	1	45 seconds	7
			2	25 seconds	5.49
			3	3 minutes	14
			4	23 seconds	5.46
			5	37 seconds	11
			Average	62 seconds	8.59

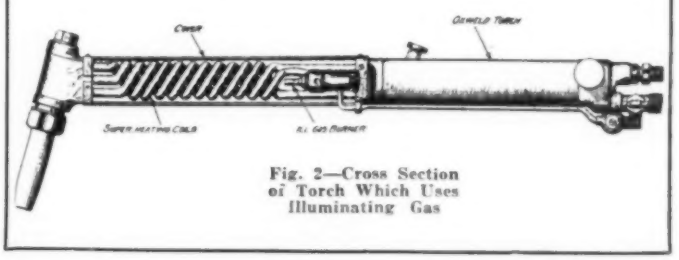


Fig. 2—Cross Section of Torch Which Uses Illuminating Gas

latter pressures are used for all small sections.

Tips also vary according to the size of the cuts. For the large cuts, that is, from 10 x 10 inches up to 12 x 22 inches, which is the largest section encountered at the Everett foundry, the most successful design of tip has six preheating slots arranged radially around the central cutting hole. These slots have a cross sectional area of 0.08 x 0.125 inches. The central cutting hole is made with a No. 30 standard gage drill. For cutting sections 8 x 8 inches or smaller, the tips have six preheating holes, size No. 52 drill, and a central cutting hole, size No. 48 drill.

Experimental Work Extensive

Experimental work at Everett has covered nearly all phases of gas welding. A year ago, at the suggestion of Dr. Adolph Krebs, the General Welding Equipment Co., Boston, the city gas was enriched by benzol. It was found that the gas would take as much as 3 per cent benzol. This gave a marked increase in heat. Tests showed that one cubic foot of gas contained 535 B. t. u. and one cubic foot of a mixture of gas and 3 per cent benzol contained 655 B. t. u. Thus 3 per cent benzol adds approximately 20 per cent heat value.

Through experimenting in actual cutting many of the early difficulties have been eliminated and it has been possible to omit the benzol and get highly satisfactory results. Part of the early trouble apparently was psychological as the operators felt that the gas was not hot enough to start cutting.

In most of the experimental work at Everett, the gas used was supplied in high pressure cylinders. These cylinders are furnished commercially at about 1800 pounds pressure and the pressure was reduced to any pressure desired for the work by regulators. A tip which works well with hydrogen will not work with city gas. Therefore, much attention was given to tip design.

Actual results shown in the accompanying table serve to illustrate the efficiency of the city gas oxygen torch in cutting steel risers. City gas-oxygen flame is a little slower to preheat than a hydrogen-oxygen flame. Having once started to cut the time seems to be practically identical for both methods. When using city gas it is particularly difficult to start the cutting on a cylindrical or smooth curve surface. If it is possible to start the cut on a fairly sharp corner much time is saved. For that reason it is good practice to design risers with an edge or corner at a convenient place for the operator to start cutting.

Compares Refractories

(*Concluded from Page* 694)

lithic linings in boiler furnaces are quite common, although the same thing cannot be said of cupolas. The writer recently had a satisfactory experience in using a kaolin monolithic lining. This lining was rammed into place, but a cement gun probably would give even better results. Particular care in burning had to be given in the case of kaolin because of its highly refractory character. This material in the breast proved a failure for the reason already assigned.

Considering other possible refractory materials for cupola linings a study of the equilibrium diagram of the alumina—silica system as prepared by Bowen & Greig of the Geophysical laboratory will prove of unusual interest. Kaolin (46 per cent Al_2O_3), sillimanite (62 per cent Al_2O_3), and mullite (71 per cent Al_2O_3), are materials that would lend themselves favorably to cupola linings but they meet the same objection as the so-called super-refractories. First cost is so high as to discourage their adoption in place of the usual type of fire clay brick or cupola blocks.

Causes for Losses in a Steel Foundry

Question: Kindly supply me with the recipe for a good green sand facing for steel castings weighing between 25 and 500 pounds. The molds for the lighter castings are stacked and both light and heavy castings are poured from a bottom-pour ladle. The molds are made entirely in green sand and I find that the sand cuts and also burns on to the casting. The face of each mold is covered with powdered silica before it is closed. At present the facing sand is made up of 2/3 old sand and 1/3 new sand with one shovel full of clay added to each batch in the mill. The new sand is made up of one part silica sand and one part millville gravel.

I should like to know how to prevent a wavy surface on a casting shaped like a box, with sides 20 inches square, open top and bottom, and with a metal thickness of 3 inches. The mold is jolted on a machine.

To what extent is the phosphorus in iron ore absorbed by the steel made in an acid lined electric furnace? For example, if I changed from an ore containing 0.03 per cent phosphorus to one containing 0.07 per cent, what phosphorus content should I anticipate in the steel?

Answer: A good facing for steel castings is made from three parts of old sand to one part new sand with one shovel full of clay to each barrow load of sand. That approximately is what you are doing at present and simply illustrates the fact that more than a formula is required in the preparation of facing sand. The ideal sand for molds into which steel is to be poured is pure silica sand, but since this sand has no cohesion it must be bonded artificially with some material to hold the body of sand in shape after the pattern has been removed. Clay is the most convenient agent and the one usually employed for this purpose. Clay is not as refractory as sand and will fuse when brought into contact with molten steel. Therefore it follows that as the proportion of clay is increased, the refractoriness of the facing sand is decreased. Obviously the remedy for a condition where the sand fuses to the casting is to reduce the quantity of clay in the facing sand. The old sand contains a quantity of clay, the millville gravel contains clay and then you add more clay to each batch in the mill. For a start we suggest that you cut out the shovel full of clay. Simply mix the old and new sand in the mill. If the castings still show signs of scabbing cut out the millville gravel.

The wavy surface on the high walls of your castings probably is due to slow pouring. The metal creeps up the walls of the mold and the skin sets temporarily now and again as it advances. Provide a generous runner and set of gates and then drive the metal in so that the mold will fill rapidly.

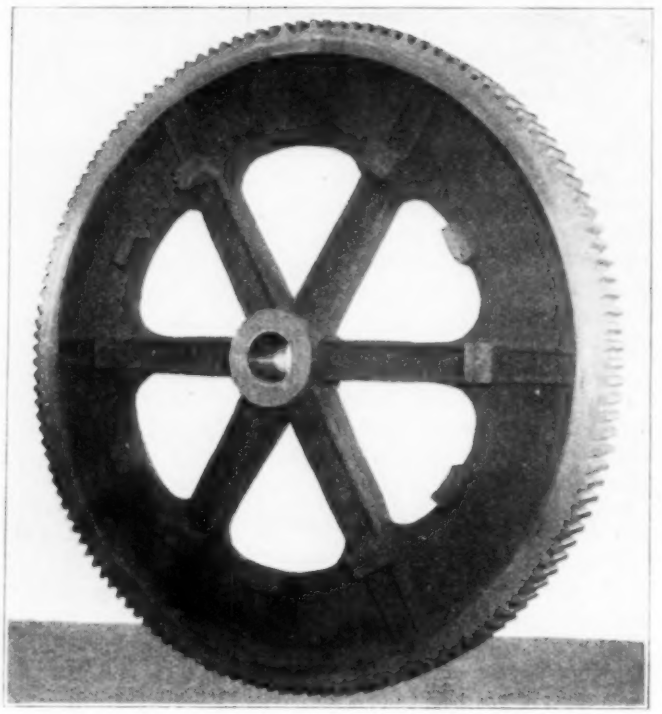
Practically all the phosphorus in the ore will be absorbed by the steel.

Make Equipment Sales

The Royer Foundry & Machine Co., Wilkes-Barre, Pa., has sold to the Allis-Chalmers Works, Norwood, O., one sand separator and blender through the Fenton Foundry Supply Co., Dayton, O. Another machine of the same type was sold to the Terre Haute Malleable & Mfg. Co., Terre Haute, Ind., through the Fenton company.

Domestic exports of foundry and molding equipment amounted to $92,918 for the month of June according to a report from the bureau of foreign and domestic commerce.

Builds Gears with Steel Ring and Cast-Iron Center



Forged and cast main drive gear with 135 teeth and 6-inch face

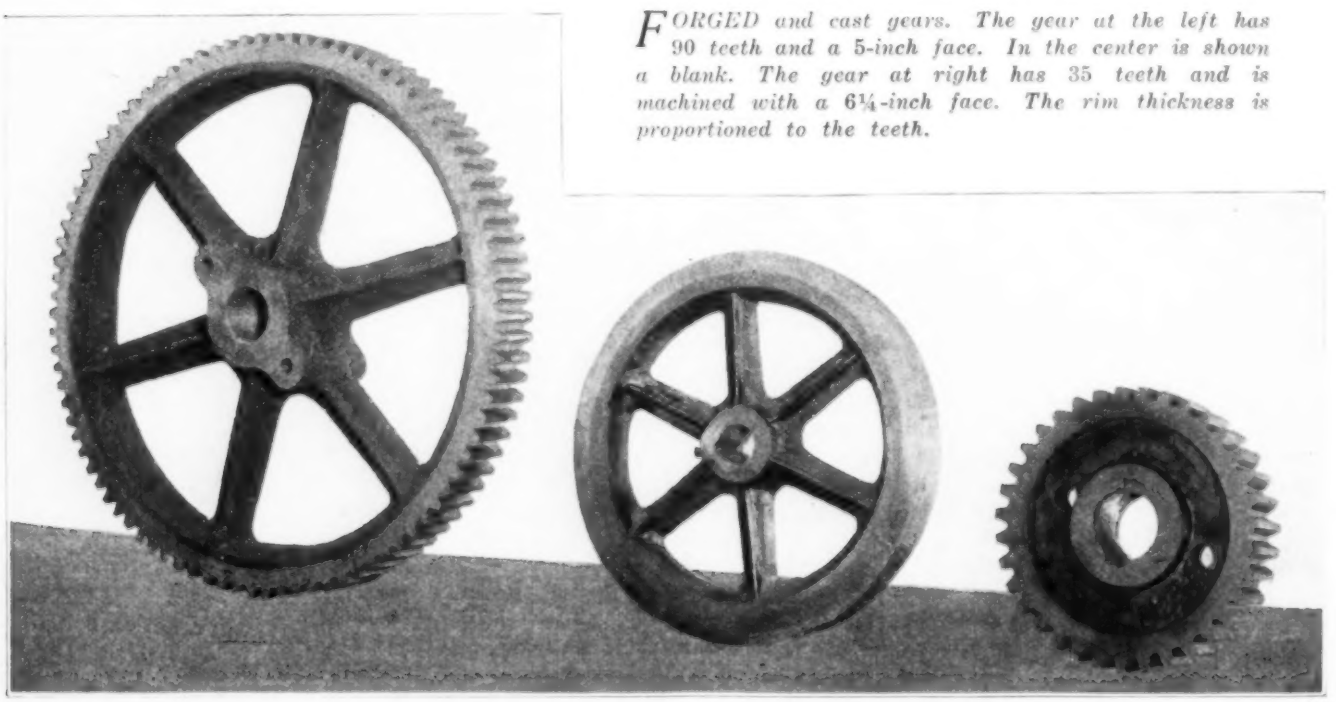
A GEAR design, which has forged steel teeth and a semisteel hub, has been originated and developed by the Hill Clutch Machine & Foundry Co., Cleveland. The construction is simply an annular forged ring in which is cast a hub either with web or arms depending on the dimensions. After casting the completed gear is finish machined and the teeth cut.

In making the weld between the steel and cast iron, multipearlite steel surfaces are brought in touch with a heavy current of hot molten iron. The amount of steel surface and of the surplus iron poured against the steel is proportioned to the diameter and the face and pitch of the gear, or to the diameter and face of the flywheel in case this is being made.

Sound homogeneous teeth are certain with this construction. The annular forged ring is dense, uniform tough steel, without blowholes, hard spots, slag inclusions or other imperfections. The semisteel center requires no annealing and, hence, there is no warping. The junction of the steel rim and semisteel center is a laminated weld of steel and iron and the finished gear is one integral piece. The thickness of the forged steel rim is proportioned to the teeth. Any height of tooth or width of face can be cut. The hubs have both ends faced and are tapered keyseated.

The semisteel center is produced with standard pattern equipment to insure uniform design. Shear pin hubs, special bolting lugs and other conditions are accomplished easily with this process. It also is adapted to machine cut spur gears. By applying the same idea to flywheel construction, practically indestructible wheels can be made for high speeds.

Harnischfeger Corp., Milwaukee, has opened a new branch office at 330 Gateway Bank building, Minneapolis. P. H. Sackett, district manager will be in charge of this office assisted by J. C. Yetter.



FORGED and cast gears. The gear at the left has 90 teeth and a 5-inch face. In the center is shown a blank. The gear at right has 35 teeth and is machined with a 6¼-inch face. The rim thickness is proportioned to the teeth.

Milestones in Foundry Progress

As Recorded in the September Issue of THE FOUNDRY, Thirty, Twenty and Ten Years Ago

1897

RADIATORS made on hydraulic molding machines were mentioned in the leading article of THE FOUNDRY for September, 1897. This was one of the features of the description of the plant of Sulzer brothers, Winterthur, Switzerland. Much of the equipment used was made in America.

* * *

The fifth anniversary of THE FOUNDRY was commemorated by a short editorial comment in this issue.

* * *

This makes THE FOUNDRY just thirty-five years old this month. Our health is fine, thank you.

* * *

The growth of the malleable iron business has been something marvelous, nor is there any sign that it has anywhere reached its limit.

* * *

Malleable iron castings still were unusual and some of them were sold under the name of steel, to circumvent the suspicion of the public with regard to the untried metal. The prophesy of thirty years ago has been substantiated.

* * *

Hilarity reigned at the meeting of the Plumbago club, according to the entirely fictitious account in the September, 1897 issue. Discovery of S. T. Johnston's Scottish ancestry was inferred.

* * *

A paper on the making and care of crucibles by J. A. Walker, vice president of the Joseph Dixon Crucible Co., gave valuable pointers.

* * *

The Belle City Malleable Iron Co., Racine, Wis. just had completed a new air furnace and was planning a foundry addition. J. T. Llewellyn was manager at that time.

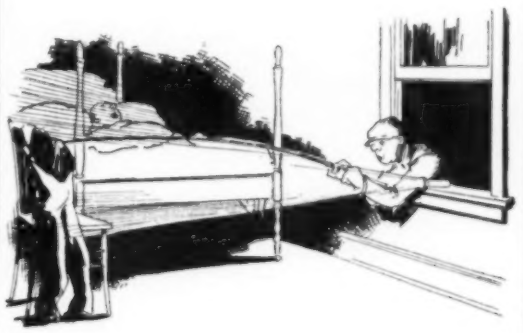
* * *

To my mind, the next twenty years will find a remarkable change in foundry management. The superintendent or manager will be what he should be, an expert in everything connected with his work. He must be able to step into anyone's place, should occasion require it. That is to say, he must be fitted to be foreman, accountant, chemist, etc.

RICHARD MOLDENKE

* * *

Faked Foundry Facts



A Long Lift

Your forecast also came true, Doctor!

1907

TO COMMEMORATE its sixteenth anniversary, THE FOUNDRY for September, 1907 carried an announcement of a change from the small 6½ x 9½ page size to the standard size in which it appears today. This page size was maintained without change except for a few months during the War when a conservation appeal resulted in reducing the measurements of the page and condensing the type material to save paper. This issue also marked the first appearance of the Data Sheet.

* * *

The new plant of the Prescott Co., Menominee, Mich. was described. This foundry made iron and steel castings for logging machinery.

* * *

Another plant just completed, and described in detail, was that of the Hill Clutch Co. Cleveland.

* * *

Although organized only four years previously, the British Foundrymen's association, as it then was known, had an unusually successful convention at Sheffield that was reported in full. Herbert Pilkington then was president and F. J. Cook was first vice president.

* * *

F. J. Cook became better known to American foundrymen in later years through his writings and through his visit to this country, in 1922 when he contributed the first exchange paper on the part of his association.

* * *

Iron foundries were crowded with orders in 1907 and were calling for deliveries of pig iron which was selling at about $19 a ton.

* * *

The Menefee Foundry Co., Ft. Wayne, Ind., was erecting an extensive addition to its plant.

* * *

The A. F. A. was planning to hold its 1908 convention in Toronto. Canadian manufacturers arranged to permit the passing of all foundry exhibits without paying duty.

1917

BOSTON was the chosen city for the A. F. A. convention and exhibition in 1917. This first wartime convention naturally reflected the universal interest of the times in war materials. The program announced carried a number of papers on munitions.

* * *

Among the local men prominent in arranging for entertaining Boston visitors during the week of Sept. 24, 1927, were W. J. Lavelle, E. A. Tutein, W. A. Viall, R. D. Walker, Robert E. Newcomb, George H. Gibby, George A. Ray, Charles L. Newcomb, Henry A. Carpenter, Walter M. Saunders, A. B. Root, Jr. and, of course, Fred F. Stockwell, secretary of the New England Foundrymen's association.

* * *

A review of twenty-five years progress in the industry, contemporary with the first twenty-five years of the life of THE FOUNDRY, was written by such men as W. J. Keep, J. H. Whiting, Richard Moldenke, John Hill, Enrique Touceda, J. P. Pero Frederic B. Stevens, A. E. Outerbridge, Jr. and David McLain

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Suggestion Withdrawn

JUST twenty years ago this month, THE FOUNDRY published the first of the Data Sheet series. In each subsequent issue some new item of information for immediate use, or for reference, has been offered to the foundry industry. The reference factor in making this feature valuable was appreciated from the inception of the Data Sheet idea and the material was set in convenient form for subsequent filing in loose leaf binders. A note to this effect was carried at the bottom of the first and each subsequent sheet.

APPARENTLY, THE FOUNDRY unwittingly transgressed a postal regulation, for early in August, 1927, a communication from the post office department at Washington, directed attention to an infringement, the communication saying in part:

> "With respect to THE FOUNDRY DATA SHEET—it is noted that the following matter is printed at the foot of the page:
>
> "'Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.'
>
> "In this connection invite the attention of the publishers to paragraph 6, section 441, P. L. and R. and advise them for their future guidance that since THE FOUNDRY DATA SHEET is intended for detachment and subsequent use and occupies an entire page, it must be regarded as constituting more than an 'incidental feature' of the publication in which it is inserted and, therefore, is not permissible under the provisions of the regulation cited in copies of THE FOUNDRY mailed as second-class matter. The note at the bottom of the page with reference to its detachment and subsequent extraneous use must therefore be omitted."

THE FOUNDRY accedes gracefully to the ruling in this regard and regrets that its transgression was not sooner called to attention. The offending line does not appear on this, nor will it be used on future issues of the Data Sheet. Fortunately, after considerable thought and study the idea was conceived in 1922 that many of the Data Sheet tables, practical hints, formulas, definitions and detailed methods might be found valuable in book form. Accordingly, *Foundrymen's Handbook*, a selection of the best of this material from 1907 to 1922 was compiled and published. Later data sheets probably will be assembled for a second edition of this work in the near future. This will avoid the necessity of clipping and binding the sheets as they appear in each issue of THE FOUNDRY.

¶ Vacation Is Over

ACCORDING to published newspaper reports Charles M. Schwab was in his usual optimistic mood recently while attending the ceremonies incident to the opening of the Peace bridge across the Niagara river and connecting Buffalo, N. Y., with Fort Erie on the Canadian side. Quite naturally he had for his theme peace and prosperity. Peace because the bridge was erected for and will act as a tangible symbol of "3000 miles of border line and 100 years of peace." Also because he is a firm believer in peace and on more than one occasion has claimed he willingly would see the great gun shops and armor plate departments of the Bethlehem Steel Corp., sunk in the depths of the sea if such a proceeding would hasten universal peace among nations. Prosperity is a favorite theme with the optimistic chairman of the greatest of the independent steel companies.

HE ADMITTED some let-down recently in the production of iron and steel, but claimed it was only a natural seasonal phenomenon. Quite confidently he looked forward to a substantial pickup when the vacation season was over, the captains of industry and their first mates were back at their desks, strengthened and invigorated in body and mind and in proper condition to keep up with the procession when Industry hits a proper marching stride in the coming fall. Mr. Schwab enjoys a national, perhaps it would be more proper to say international reputation for his optimism and a recent stiffening in the price of pig iron would seem to indicate that his optimism is based on a fairly reliable foundation.

Trade Trends in Tabloid

WHILE foundry operations have been slack during the summer months, several conditions point to an early increase in production of castings in some lines. Sales of pig iron in Cleveland, Philadelphia and New England territories, were large during the latter part of the past month. Estimates of from one half to one billion dollars increase in the farmers' incomes, due largely to higher prices, predict heavier buying of agricultural implements. Production of passenger automobiles in the United States and Canada again declined in July, the the production for that month being 242,144 cars as compared with 290,188 cars in June. Further delay in the appearance of the Ford car and failure of the new models announced during the month to produce the anticipated demand will result in little improvement being shown in August. Decline of approximately $100,000,000 in building awards in July undoubtedly will be reflected in curtailed operations in foundries making supplies. The average melt as reported by the Ohio State Foundrymen's association, was 72.3 per cent of normal in July as compared with 84 per cent in June and 76.8 per cent in July, 1926. Nonferrous foundries in Ohio were operating at 69 per cent in July as compared with 78 per cent in June. Bookings of steel castings declined from 63 per cent of shop capacity in June to 54 per cent in July.

RAW MATERIAL PRICES

August 23, 1927

No. 2 foundry, Valley	$17.50 to 18.00
No. 2 southern, Birmingham	17.25
No. 2 foundry, Chicago	19.50
No. 2 foundry, Philadelphia	20 76
No. 2 foundry, Buffalo	16.00 to 17.00
Basic, Valley	17.50
Basic, Buffalo	16.00 to 17.00
Malleable, Chicago	19.50
Malleable, buffalo	16.50 to 17.00

Coke

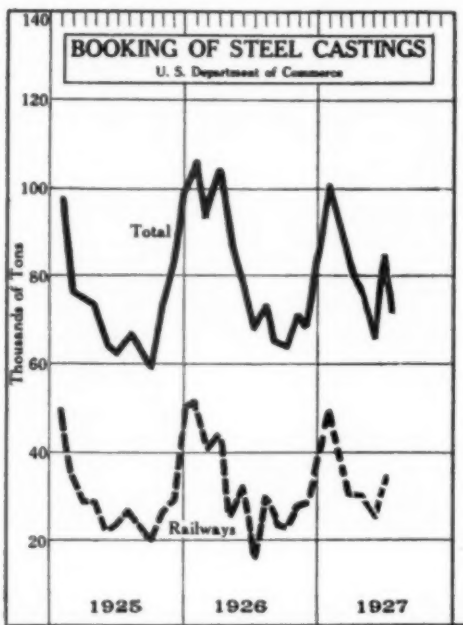
Connellsville foundry coke	$4.00 to 4.75
Wise county foundry coke	4.00 to 5.00

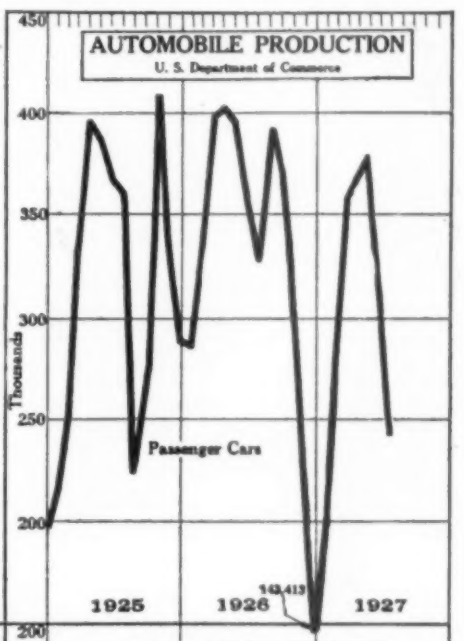
Scrap

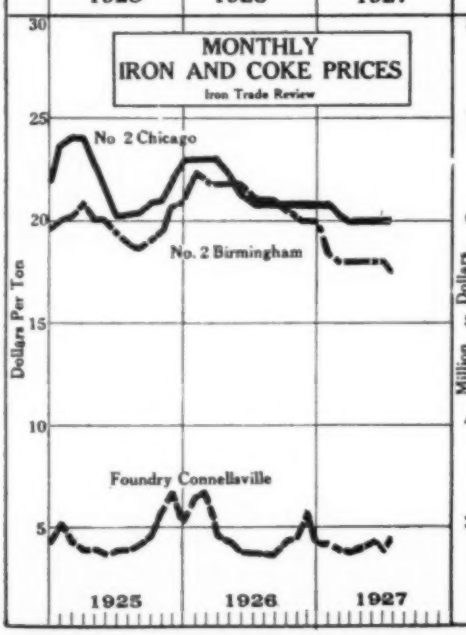
Heavy melting steel, Valley	$15.50 to 16.00
Heavy melting steel, Pitts	15 50 to 15.75
Heavy melting steel, Chicago	12.25 to 12.75
Stove plate, Chicago	12.75 to 13.25
No. 1 cast, New York	13.00 to 13.25
No. 1 cast, Chicago	15.00 to 15.50
No. 1 cast, Philadelphia	16.00 to 16.50
No. 1 cast, Pittsburgh	15.00 to 15.50
No. 1 cast, Birmingham	14.00 to 15.00
No. 1 cast, Buffalo	15.00 to 15.50
Car wheels, iron, Pittsburgh	15.00 to 15.50
Car wheels, iron, Chicago	14.50 to 15.00
Railroad malleable, Chicago	14.50 to 15.00
Agricultural Mal., Chicago	13.00 to 13.50
Malleable, Buffalo	15.00 to 15.50
Railroad malleable, Pitts	14.50 to 15.00

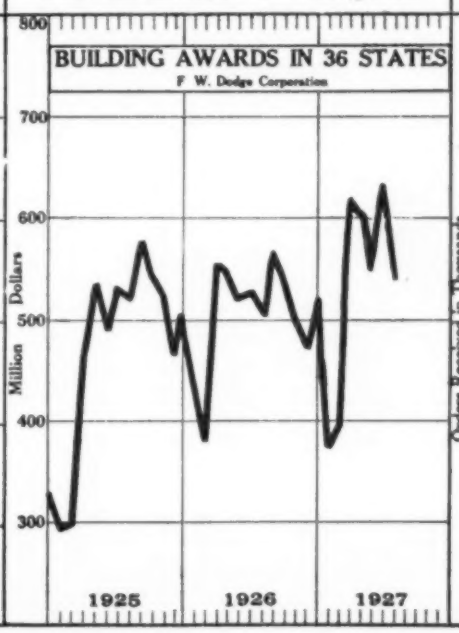
Nonferrous Metals

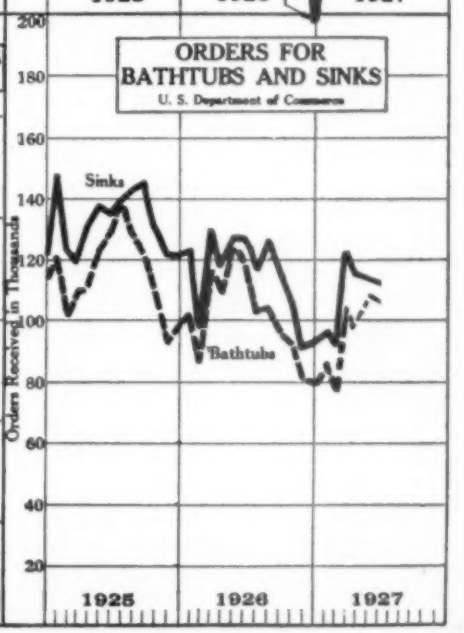
	Cents per pound
Casting copper, refinery	13.00 to 13.12½
Electro copper, producers	13.12½ to 13.25
Straits tin	63.75
Lead, New York	6.70 to 6.75
Antimony, New York	11.37½
Nickel, electro	39.00
Aluminum, No. 12, producers	24.50
Aluminum, No. 12, remelt	18.50 to 19.50
Zinc, East St. Louis, Ill	6.37½ to 6.40











Comings and Goings of Foundrymen

W. R. BEAN, for the past 11 years research engineer, Eastern Malleable Iron Co., Naugatuck, Conn., has resigned to accept a position as vice president of the Grindle Fuel Equipment Co., Harvey, Ill., a subsidiary of the Whiting Corp. Mr. Bean has served almost continuously in the malleable foundry field for 26 years. He spent one year at the Virginia Polytechnic institute and then became a special apprentice with the Atlantic Coast Line railway. He then became associated with the Symington Co., Rochester, N. Y., and during the

W. R. BEAN

12 years he was connected with that firm rose from inspector to works manager in charge of foundries at Corning, N. Y., and Rochester. Four years later he became associated with the Eastern Malleable Iron Co. Mr. Bean was a director of the American Foundrymen's association from 1918 to 1922; a vice president in 1921 and served as president during 1921-22. He is an honorary member of the American Foundrymen's association and a member of the American Institute of Mining and Metallurgical Engineers, American Society for Testing Materials, American Chemical society and the American Society for Steel Treating.

James L. Gibney has been appointed assistant superintendent of the W. P. Taylor Co. foundry in Buffalo.

H. Lenneman, chief engineer, Halbergerhuette, Brebach-Saar, Germany, now is in the United States visiting pipe and fittings foundries.

Verner R. Velander, formerly secretary and treasurer, Pittsburgh Valve Foundry & Construction Co., Pittsburgh, recently disposed of his interests to organize the Verner Steel Products Co., Chicago.

C. C. Smith, secretary-treasurer, Toledo Steel Casting Co., Toledo, O., was elected president of the Ohio State Foundrymen's association at the convention held at Cedar Point, O., Aug. 19-20. More than 22 years ago Mr. Smith started work with the Toledo Steel company as a pattern clerk. Later he worked in various positions including that of assistant general manager. Mr. Smith has been vice president of the Ohio State group for the past two years. Don McDaniel, vice president of the Hamilton Foundry & Machine Co., Hamilton, O., was elected vice president of the association. Mr. McDaniel attended high school at Fort Recovery, O., and Winchester, Ind., and received his degree from Rose Polytechnic institute, Terre Haute, Ind., in 1907. He served a special apprenticeship course with the National Malleable Castings Co., Indianapolis, until 1910 when he became connected with the Indianapolis plant of the Link-Belt company as order clerk and later as draftsman and works engineer. In 1918 he became production manager of the Hamilton Foundry & Machine Co., Hamilton, O., and in 1923 was made vice president. Edgar Sands, purchasing agent, the Superior Gas Engine Co., Springfield, O., was reelected treasurer of the association. Mr. Sands was educated in the public schools of Champaign county, Illinois and later attended business college at Springfield, O. His first experience was gained with the Ohio Southern Railroad, Lima, O., and the William Baily Co., Springfield. He became connected with the Superior Gas Engine Co., 27 years ago and worked in several departments before being made purchasing agent. Arthur J. Tuscany, Cleveland, was re-elected secretary-manager of the association.

Prof. A. E. White, director of the department of engineering research, University of Michigan, Ann Arbor, Mich., now is in Europe where he will attend two scientific conferences at Warsaw, Poland, and Amsterdam, Holland.

L. E. Keen, formerly general superintendent, Wanner Malleable Castings Co., Hammond, Ind., is president of a new foundry which will be located at Griffith, Ind.

G. L. Fisk has been appointed chief engineer, Mesta Machine Co., Pittsburgh. Mr. Fisk formerly was chief engineer, Pittsburgh Crucible Steel Co., Midland, Pa. and succeeds L. Iverson who now will act as consulting engineer. He was educated in

G. L. FISK

Sweden and became associated with the Cambria Steel Co., later he served as resident engineer for Julian Kennedy and Sahlin & Co., Ltd. during the construction of the Tata Iron & Steel Co. in India.

Carlo Vanzetti, one of Italy's leading foundrymen and vice-president for Italy of the Association Technique de Fonderie de Paris, has been honored by the French government with the decoration of the Legion of Honor. Mr. Vanzetti, who was born in Padua, Jan. 6, 1866, is managing director of a large steel foundry which was established in Milan by his uncle. During the war Mr. Vanzetti cooperated in the organization of a large number of shell factories in Italy. He has enjoyed long associations with French industrialists, and is professor at the Ecole Superieure

de Fonderie, Paris. Mr. Vanzetti also is Commander of the Order of the Crown of Italy and Commander of the Order of the British Empire.

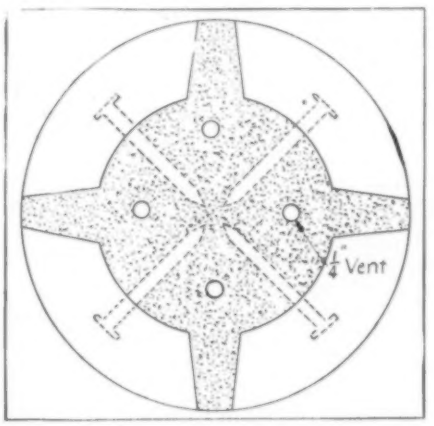
Achille Brizon has resigned as general secretary of the Association Technique de Fonderie de Paris, and has been succeeded by Charles Koehler, managing director of Société des Fonderies de Saint-Rouen, near Paris.

W. L. Perkins, who was reported as being manager of the Addystone Pipe Works, Addystone, O., for 42 years in the Aug. 1 issue of THE FOUNDRY, only held this position for 15 years. Charles Seitz who succeeds Mr. Perkins formerly was superintendent of the Scottdale, Pa., plant of the United States Cast Iron Pipe & Foundry Co.

Chills Wearing Surface of Shaft Bearing

Question: We have an order for a number of solid bearings for a 2 15/16-inch shaft in which the inside surface has to be chilled. We have tried several methods and find that while we can secure a good chilled face, the castings crack and therefore are useless. We shall appreciate your advice on how to secure good castings.

Answer: To prevent the castings from cracking you will have to provide a core that will yield to the contraction of the iron. A suggested design of core is shown in the accompanying illustration in which the interior is shown made of sand almost surrounded by four chill segments. The chills are held in place against the sand center by wire nails incorporated in the chills at the time they are made. Three or four in each is sufficient. In making the core the chill pieces are placed in position



FOUR SEGMENTAL CHILLS ARE HELD AGAINST THE SAND CENTER BY WIRE NAILS

vertically in a whole corebox with the outside face of the chill touching the face of the corebox. After the corebox has been rammed full of sand it is separated into two parts and removed leaving the core standing on the plate. The small body of sand between adjoining chills will not interfere materially with the chilling action, but it will yield sufficiently to prevent the casting from cracking and also will facilitate the removal of the chill pieces from the casting. After the core is dried it may be blackwashed in the usual manner to insure a clean and uniform opening in the casting. However, precaution must be observed. The blacking must be thoroughly dried, otherwise the metal will *blow* from the chills. It is assumed that you intend to finish each hole by grinding.

Gives Gear Formula

Hard cast bronze for gears and bearings according to S. A. E. specification No. 62 has the following composition: Copper, 86.00 to 89.00 per cent; tin, 9.00 to 11.00 per cent; lead, max. 0.20 per cent; iron, max. 0.06 per cent; zinc, 1.00 to 3.00 per cent. The ultimate strength will be about 30,000 pounds per square inch; yield point, 15,000 pounds per square inch; elongation, 14 per cent in 2 inches.

Use Many Motors

The stove, range, domestic heating apparatus, and steam fitting manufacturers used 18,367 electric motors which supplied 184,608 horsepower during 1925 according to a report issued by the bureau of census.

Foundry Association Directory

American Foundrymen's Association

President, S. W. UTLEY, Detroit Steel Casting Co., Detroit; secretary-treasurer, C. E. HOYT, 140 South Dearborn street, Chicago; technical secretary, R. E. KENNEDY, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, G. H. ROLINSON, American Brake Shoe & Foundry Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 W. Eighteenth street. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, J. J. BOLAND, Griffin Wheel Co., Detroit; secretary, ROBERT HOPE, Holley Carburetor Co., Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

East Bay Foundrymen's Association
Oakland, Calif.

Secretary, H. L. MARTIN, Marchant's Foundry Co., 4401 East Tenth street, Oakland, Calif.

Metropolitan Brass Founders' Association
New York

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by President.

New England Foundrymen's Association

President, HENRY S. CHAFEE, Builders Iron Foundry, Providence, R. I.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, C. C. SMITH, Toledo Steel Casting Co., Bancroft and Smoad avenue, Toledo, O.; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, Union League club, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Pittsburgh Foundrymen's Association
Pittsburgh

President, C. D. CAREY, American Steel Foundries, Pittsburgh; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President, HYMAN BORNSTEIN, Deere & Co., Moline, Ill; secretary-treasurer, H. A. DEANE, Deere & Co., Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Tri-City Technical Council
Moline, Ill.

Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, H. H. NOTT, Smith System Heating Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meetings monthly at the Athletic club.

Obituary

Ernest Blackman Perry, president of Industrial Works, Bay City, Mich., maker of locomotive cranes and railroad wreckers, died at his home in that city Aug. 7, after an illness of one week. Mr. Perry was born at Prairie du Chien, Wis., in 1868. He was graduated from the mechanical engineering department of the University of Michigan in 1889, and in 1896 received his master's degree. In 1889 he took a position with Industrial Works as a draftsman, and was connected with the company from that time on. In 1891 he was made superintendent and mechanical engineer, and later vice president and general manager. In 1924 he was elevated to the presidency of the Industrial Works and served actively in that capacity until his death. He was a member of the American Society of Mechanical Engineers and was affiliated with various other national organizations.

Charles F. Baxter, Sr., Baxter Foundry & Machine Works, Boise, Idaho, died recently.

Phillip Dugre, retired iron founder died at his residence at Howard Beach, L. I., after a long illness. He came to this country from Germany as a young boy and conducted an iron foundry for many years, retiring about 10 years ago. He was 89 years old.

Robert Eagley, foreman for many years of the Percival Plow & Stove Co., Merrickville, Ont., died recently. He was 59 years old.

Charles F. Cox, president, Cox & Sons Co., Bridgeton, N. J., foundry and machine shop, died at his home recently after an illness of three months. He was known widely in manufacturing circles in Philadelphia and southern Jersey and was a trustee and treasurer of the Manufacturers Association of New Jersey. Mr. Cox was 65 years old.

Henry Irving Mulligan, treasurer and manager of the Aluminum Die Casting Co., Garwood, N. J., died Aug. 17 at his home in Plainfield, N. J. He was aged 44.

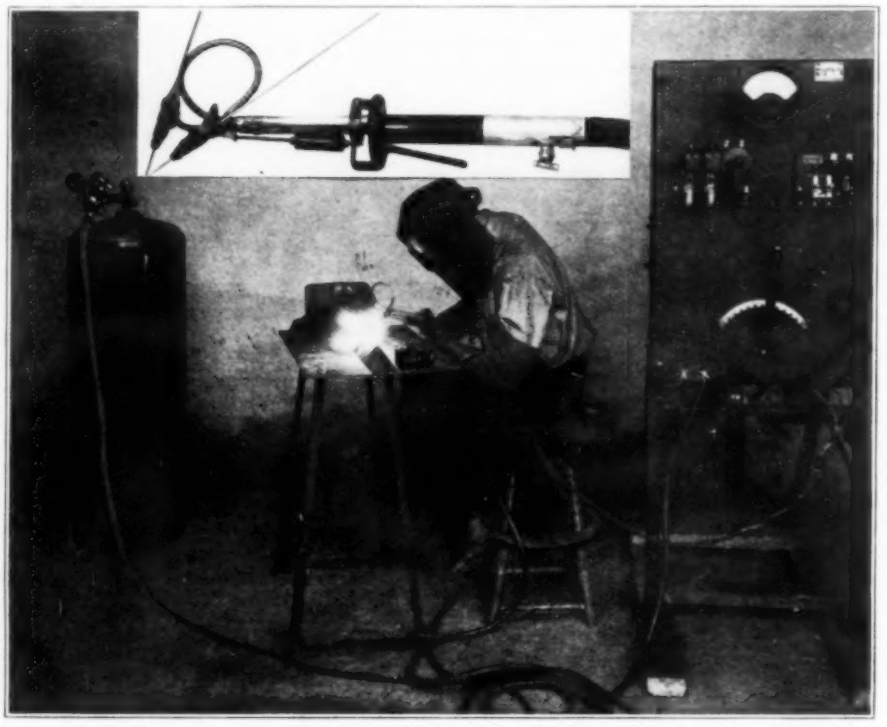
New Arc Welding Torch Also Uses Hydrogen

Atomic hydrogen, which is a powerful reducing agent, has been adapted in connection with arc welding equipment to form a new process of welding known as atomic hydrogen welding. This process is the result of research conducted by Dr. Irving Langmuir, General Electric Research laboratory, Schenectady, N. Y. Briefly, this method utilizes the passage of a stream of hydrogen through the arc between two electrodes. The heat of the arc breaks up the hydrogen molecules into atoms which combine again a short distance beyond the arc to re-form molecules. In doing so the combination liberates an enormous quantity of heat which gives more effective welding temperatures.

The apparatus, as finally designed, represents the results of many trials, extending over a period of months, made in the shops of the General Electric Co., Schenectady. The welding outfit consists of a single-phase transformer for converting the source of power to one suitable for the welding equipment; a specially designed, variable reactor to regulate the current and voltage, and the welding torch. The torch consists of a holder supporting two tungsten wire electrodes, the electric conductors connecting these electrodes to the reactor, and the tubing for the hydrogen gas.

Each electrode is supported inside a nozzle through which the hydrogen gas is forced out around the electrode. The combination of electrodes and nozzles is set at an angle and the distance between electrodes, and the flow of gas are adjustable. The electrode conductors to and through the torch are insulated heavily. When welding ceases, the welding circuit is interrupted until such time as the operator is ready to weld again. Then the circuit is restored automatically. This differs from the usual method of arc welding in that no current flows from the electrodes to the work to be welded. The circuit is completed from one electrode to the other.

The reactor consists of a U-shaped core provided with pole faces between which a pivoted armature moves. Legs of the core contain coils connected in series with the electrodes. The movable armature governs the amount of welding current and voltage by changing the air gap of the magnetic circuit and reactance. This armature is biased normally to an open position and upon a flow of current through the coils of the reactor, is attracted to a closed position. When welding ceases, it automatically resumes the open position.



NEW ARC WELDING EQUIPMENT IN OPERATION SHOWING THE REACTOR PANEL. INSET IS A VIEW OF THE WELDING TORCH

In making edge welds the metal to be welded is melted under the heat of the arc. When it is necessary to add additional metal, a filler rod must be fed into the arc similarly to the method used in gas welding. The new equipment is recommended for use on ordinary metals of less than ¼-inch thick or on difficultly welded metals of greater thickness. It is claimed that due to the absence of oxides and nitrides from the welds made by this process, it particularly is adapted to welding of special alloys which are difficult to weld.

Small Motor Frames Cast of Malleable

Question—It has been represented to us that malleable iron would be advantageous in small motor frames as its permeability was said to be high. Is this correct, and how could we determine whether we were securing a grade of malleable iron with high permeability without going to the expense of testing every shipment for this property?

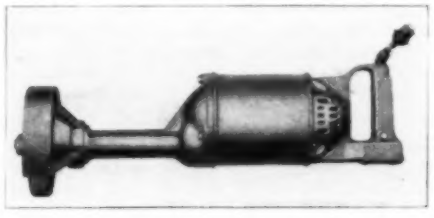
Answer—Malleable iron is much higher in permeability than gray-iron and nearly as high as steel at the lower densities, and therefore would be suitable for small motor frames, in fact, a number of electrical firms use it for this purpose.

To secure a malleable iron with high magnetic permeability the prime requisite is to be certain that the iron as cast does not have any graphite so low that all the carbon will be spots; that is, the carbon should be combined. A low carbon iron ranging around 2.5 per cent carbon as cast is desirable.

The magnetic properties are closely related to physical tests. Therefore, if you get an iron with high tensile strength and elongation, you will be practically certain of good magnetic properties. As an adjunct to this test you should break some of the castings before they are annealed, to satisfy yourself that the carbon is all in the combined state. Some foundries are regularly making iron with a tensile strength of more than 50,000 pounds per square inch which would give good magnetic results.

Builds Hand Grinder

The Cincinnati Electrical Tool Co., Madison and Edwards roads, Cincinnati, recently has introduced a new model hand grinder. The machine, which is shown in the accompanying illustration, is equipped with a ¾ horsepower motor and carries a 6 x 1-inch grinding wheel. The wheel revolves at a speed of 3600 revolutions per minute. Although the construction of the tool throughout is correspondingly heavier, simplified design has resulted in an increase in weight of only 1 pound over the ½ horsepower model manufactured by that company.



BALL BEARINGS ARE USED FOR ARMATURE AND SPINDLE

Both the armature and the spindle of the grinder are mounted with ball bearings. Broadface spiral gears, heat treated and hardened, are used throughout. The armature pinion is removable, being screwed into the armature shaft and all gears run in grease in a grease tight compartment. The end handle cover contains no mechanical parts and is designed to relieve the motor and the motor bearings of all friction load and pressure. A fully enclosed switch is located in the handle of the grinder, with a push button trigger under immediate control of the operator at all times. The guard wheel is adjustable both longitudinally and radially.

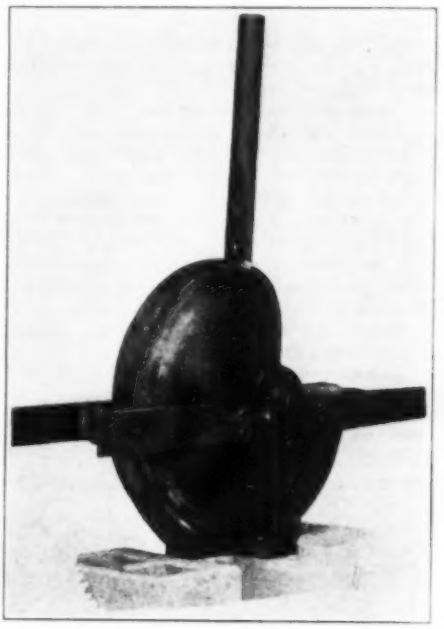


FIG. 1—LADLE IN FILLING POSITION. NOTE POSITION OF HOLE

Designs New Type of Pouring Ladle

Recently a new type of pouring ladle was designed and patented by John G. Koegle, Toledo, O. The ladle is of the bottom pouring type and as may be seen from the accompanying illustrations looks similar in form to a centrifugal pump housing. The lower part of the device is fixed and contains a hole in the lowest point. The movable part moves in the trunnions and also contains a hole which may be seen in Fig. 1. When the ladle is in the pouring position, the holes of the fixed and movable sections coincide and the contents of the ladle emerge in a stream at the bottom. Raising the pouring lever cuts off the stream. Advantages for this type of ladle are claimed to be: Exact register of the molten stream with the sprue opening; it readily is filled and emptied; metal is taken below the surface preventing the entry of oxides, etc. into the mold.

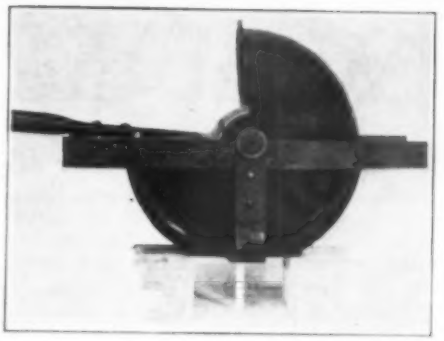


FIG. 2—DEPRESSING THE LEVER PLACES THE LADLE IN POURING POSITION

Merge Sea Coal Mills

The Rillton, Pa., sea coal mill of the S. Obermayer Co. Chicago, has been joined with the Penn Facing Mills Co., controlled by Whitehead Bros. Co., Providence, R. I. The new corporation, called the Penn-Rillton Co., will start operations Sept. 1. In addition to the production of sea coal facing, a line of core compounds and other foundry facings will be manufactured. Officers of the new firm are Theodore Kauffman, president; A. J. Miller, vice president; J. H. Whitehead, treasurer, and E. D. Frohman, secretary. Offices of the Penn-Rillton Co. will be located at Rillton, Pa.

Receives Many Orders

Orders received by the Stoney Foundry Engineering & Equipment Co., Cleveland, include one core knockout machine to Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., and vibrator and shakeout equipment to the Standard Foundry Co., Racine, Wis.; American Radiator Co., Buffalo; Oil Well Supply Co., Oil City, Pa.; Gould Coupler Co., Depew, N. Y.; John Deere Harvester Co., East Moline, Ill.; Humphryes Mfg. Co., Mansfield, O.; Grabler Mfg. Co., Cleveland; Southern Wheel Co., St. Louis; Southern Wheel Co., Toledo, O.; Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.; Conemaugh Iron Works, Blairsville, Pa.; Henry Furnace & Foundry Co., Medina, O.; Barnes Mfg. Co., Mansfield, O.; Rundle Mfg. Co., Milwaukee; Buick Motor Co., Flint, Mich.; Studebaker Corp., South Bend, Ind.; Holland Furnace Co., Cedar Rapids, Iowa, and the Lakey Foundry & Machine Co., Muskegon, Mich.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Sprout, Waldron & Co., Muncey, Pa., has taken over all the patterns and equipment of the Valley Iron Works, Williamsport, Pa.

Whiting Corp., Harvey, Ill., has let contract to Schmidt Bros., 22 East Huron street, Chicago, for a foundry addition, 70 x 160 feet.

Getchel Foundry & Machine Works, Oakland, Me., has resumed operations after a shutdown.

Star Foundry Co., West Main street, Troy, O., has completed plans for a 1-story foundry addition.

Astoria Foundry Co., Astoria, Oreg., plant was damaged by fire recently and will rebuild that portion of the plant.

Electric Steel Foundry, Portland, Oreg., will build three structures, a pattern storage unit, a pattern shop and a crane way.

General Drop Forge Co., Buffalo, W. Miller, president, 1738 Elmwood avenue, is considering plans for a 1-story foundry plant.

United States Radiator Corp., Dunkirk, Pa., has completed its new foundry addition and expects to augment its present force of employes.

Pontiac Pattern & Engineering Co., South Sanford street, Pontiac, Mich., has let general contract to M. B. Hungerford, 24 West Huron street, for a 1-story plant.

Murray Co., 3200 Williams street, Dallas, Tex., manufacturers of cotton gin machinery and equipment, plans to enlarge its plant in the near future.

Romach Co., Indianapolis, has been incorporated with $10,000 capital to conduct a general foundry business by Elwood W. Rother, E. H. Kemper McComb and Robert D. Coleman.

New Orleans Car Wheel Co. Inc., New Orleans, recently incorporated with $500,000 capital has started construction of a large foundry for the manufacture of car wheels.

Athens Stove Works, Athens, Tenn., expects to enlarge the capacity of its plant by the construction of an additional unit for its foundry department. C. L. Williams is manager.

Woodward Pattern Works, 321 North Michigan street, South Bend, Ind., has let general contract to Hay Weaver Co., 2410 South Main street, for a 2-story plant, 40 x 100 feet at 124 East Sample street.

Toledo Machine & Tool Co., Toledo, O., soon is to start construction of a new and larger factory. The contract for the first unit to cost $100,000 has been awarded to Henry J. Spieker Co., Toledo.

Messemer Mfg. Co., 2700 South Seventh street, St. Louis, has awarded the general contract for a 2-story brass foundry addition to George Moeller, 3520 Itaska street. (Noted Aug. 1).

Kilgore Foundry & Machine Co., Ulrichsville, O., a new concern, will soon have its equipment installed in its factory and expects to begin operations soon afterward. The company manufacturers toy pistols and caps.

Chaplin-Fulton Mfg. Co., Pittsburgh, William C. Chaplin, 2836 Penn avenue, secretary-treasurer, will build a 3-story brass manufacturing addition, on newly acquired property. B. H. Prack, Martin building, is architect. (Noted Aug. 15).

National Alloy Steel Co., Blawknox, Pa., has been incorporated with $20,000 capital to manufacture iron and steel and alloys by Benjamin L. Hirshfield, Rural Route No. 1, Verona, Pa., Albert C. Lehman, Schenley apartments, Pittsburgh, and F. M. Bowman, 1234 North Highland avenue, Pittsburgh.

Central Foundry Co.'s plant at Vincennes, Ind., closed for the past 18 months, will open shortly according to word from F. A. Ferguson, New York, vice president of the company. Anthony Bohnert, former manager of the Vincennes plant, has been recalled to make preparations for the reopening.

Four in One Sanitary Mfg. Co. Inc., Pittsburgh, has been incorporated with $25,000 capital to manufacture bath tubs, bathroom equipment, and plumbers' supplies, structural steel, castings and enameled ware, by Walter G. Schulz, 1216 Hillsboro street, Pittsburgh, Andrew Metz and John Evans.

McWane Cast Iron Pipe Co., Birmingham, Ala., will increase its preferred capitalization from $500,000 to $1,000,000. The firm also has developed its own process for making sand-cast pipe using mechanical operations which is expected to double production. Pipe made by the new process will be 16 feet in length and up to 12 inches in diameter.

A merger of the Farrel Foundry & Machine Co., Ansonia, Conn., and Buffalo, N. Y., and the Birmingham Iron Foundry, Derby, Conn., is proposed in a notice to stockholders of the two companies. Both firms specialize in heavy machinery for the sugar, rubber, paper, brass and copper industries.

The newly organized Keen Foundry Co., Griffith, Ind., will begin construction of a $25,000 foundry. The firm is capitalized at $40,000 and is headed by Louis E. Keen, formerly general superintendent, Wanner Malleable Casting Co., Hammond, Ind. The company will produce gray iron castings used in the automobile, radio, light fixture and other industries.

The highest bid submitted to the trustees in bankruptcy for the properties of the Kuebler Foundries, Inc., Easton, Pa., is $60,000. It was submitted by Charles B. Brunner, Easton, Pa., who is said to represent local interests. The bid is to be submitted to the court before confirmation and it is understood that acceptance will be opposed on the ground that the price is too low.

A merger of six of the leading companies in the radiator industry to form the National Radiator Corp., New York, recently was announced. The firms involved in the merger include the National Radiator Co., the Niagara Radiator & Boiler Co., Continental Heater Corp., Utica Heater Co., Union Radiator Co. and the Gurney Heater Mfg. Co. Two of the plants are located at Johnstown, Pa., two at New Castle, Pa., and one each at Trenton, N. J., Utica, Dunkirk and North Tonawanda, N. Y., Framingham, Mass., and Chicago. Operating management will continue in the hands of former executives of the predecessor companies. John H. Waters, formerly president, National Radiator Co. will be chairman of the board; Edward Norris, formerly president, Utica Heater Co., will be president; E. C. Andrews, formerly president, Niagara Radiator & Boiler Co. will be chairman of the advisory committee.

New Trade Publications

ELECTRIC FURNACES—C. I. Hayes, industrial electric heating engineer, Providence, R. I., has issued a bulletin describing a type of furnace for forging, heat treating, melting nonferrous metals, hardening, testing fire clays and firing pottery and ceramics. Illustrations and diagrams cover its construction and operation.

TUMBLING MILLS—Whiting Corp., Harvey, Ill., in a current bulletin presents its new tumbling mill. It has been designed to withstand the severe punishment encountered in foundry use. Door fastenings, bearings and other parts are made rugged to give long wear. Replacement of worn parts is easy as they are interchangeable. The bulletin is fully illustrated.

CRAWLERS—The Link-Belt Co., Chicago, has published a 15-page booklet describing its crawler with articulated treads. These crawlers may be used for a variety of purposes including shoveling, dragline work, pile driver, lifting with magnet, unloading cars, etc., by attaching the proper boom. The crawlers are supplied with either internal combustion engine or electric motor drive.

WELDING—Fusion Welding Corp., Chicago, has published a 24-page pocket-size booklet describing its welding supplies and equipment. These include an electric welder, welding rods, welding cable, gloves, helmets, etc.

HANDLING MACHINERY—Henry B. Newball Corp., Garwood, N. J., manufacturer of cranes, trolleys, hoists and elevators, has issued a broadside to indicate the broad use of its devices in lifting, piling and tiering various packages of material economically Pictures tell most of the story, with enough text to make it clear.

ELECTRIC EQUIPMENT—General Electric Co., Schenectady, N. Y., has issued two bulletins, covering drum controllers and solenoid-operated air circuit breakers. They are illustrated and present appropriate engineering data.

STEEL PLATFORMS—Truscon Steel Co., Youngstown, O., calls attention in a bulletin to its steel boxes and platforms for storing and moving materials economically. They are adapted to use with all types of hand and power lift trucks and cranes. The bulletin is well illustrated.

STEEL PARTITIONS—E. F. Hauserman Co., Cleveland, is distributing a broadside to show wide use of its line of steel partitions for office and industrial use. Typical installations are illustrated and a list of prominent structures so equipped is given.